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newsletter
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11

MINISTERO DELL'AMBIENTE
E DELLA TUTELA DEL TERRITORIO E DEL MARE

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Editorial

Paolo Costa, President of the Venice Port Authority

For some decades, western countries have been strongly committed to the environmental recovery of those sites which have been deeply compromised by centuries of industrial activity, without regard to the depletion and degradation of non-renewable resources.
The problem of environmental recovery is both broad and complex; many high-polluting substances – strictly linked to the different processes of product transformation – characterize contaminated sites, and those substances deeply affect the ecosystem in terms of air, soil, and water pollution. The effects of environmental degradation often go beyond the borders of the industrial site and threaten the equilibrium and salubrity of the surrounding area with direct or indirect consequences on population health and quality of life. The environmental damage becomes not only an economic matter but also a social one, with implications even more difficult and complex to manage.
To avert such a threat, the following process is usually followed:
_ identification and classification of the types of pollutants;
_ screening and selection of the recovery activities;
_ process of environmental remediation.
It is easy to understand that this process is extremely demanding, both technically and financially, as a balance between the "duty" to environmental recovery and the "convenience" has to be found on the basis of laws and regulations. Hence, the process of environmental recovery and the management of contaminated sites are, at present, based on the principle of optimization: safety and remediation works are decided according to the end use assigned to the area, which also determines the kind of decontamination process to bring it down to bearable limits. In this way, the benefits are maximized and the costs for the qualitative recovery of the site reduced.
The European Union issued a series of guidelines and directives in order to coherently regulate the policy and technical aspects of such an urgent and complex problem, common to all member states. Regulatory frameworks followed, and today they provide the member states with institutional, technical and legal tools that, in most cases, offer final solutions within given times (except for the financial aspect).
Fast developing countries such as China are facing similar problems. The experience of the western countries can significantly contribute to overcoming such emergencies in a fast and efficient way. To conclude, the constant dialogue on these topics between the two sides of the world will also benefit the western countries, if such a dialogue offers the opportunity to develop new and more advanced tools for the management of contaminated sites. In the end, the best practices for contaminated site management and environmental recovery will no longer be the property and expertise of just one single region.

news and events

Copenhagen 2009: Climate Change

The most urgent global environmental issues will be discussed between the 7th and 18th of December 2009 at the United Nations Convention on Climate Change in Copenhagen, Denmark.
The conference (COP 15), a crucial debate for the future of the planet, is open to the parties of the United Nations Framework on Climate Change Convention (UNFCCC) and observer states (governments), the United Nations, and other observer organizations.
During the 12-day conference, the world's leaders will discuss the main issues concerning climate change in view of an agreement which defines a follow-up strategy to the Kyoto Protocol.
For more information and an update, please visit the official website of COP 15: www.en.cop15.dk

IMELS Minister on Official Visit to China

The Italian Minister for the Environment, Land and Sea, Mrs Stefania Pretigiacomo, visited China from the 13th to the 16th of September 2009, on her first official journey to the mainland. In her busy Chinese calendar, Minister Prestigiacomo had bilateral talks with her Chinese colleagues: Zhou Shengxian, Minister of Environmental Protection, Wan Gang, Minister of Science and Technology, Xie Zhenhua, Vice-Chairman of the National Development and Reform Commission, and Beijing's mayor.
On the occasion of such meetings, a new memorandum of understanding between China and Italy was signed to strengthen the cooperation in the field of natural resource protection, environmentally-sound technologies development and transfer, mitigation and adaptation to climate change, and sustainable urban development. Specific agreements were also reached with regard to transferring and disseminating to China advanced technologies for controlling vehicle emissions and near-zero emissions from coal power plants respectively, with the Italian companies Pirelli and ENEL.
Mrs Prestigiacomo also took part in the inauguration ceremony of the Environmental Conventions Building (4C Building) in Beijing, headquarter of MEP departments and government agencies responsible for international environmental cooperation and enforcing Multilateral Environmental Agreements. The Italian-designed office building, co-funded by IMELS, is a flagship for sustainable architecture equipped with Italian technologies and materials able to reduce the energy demand and related greenhouse gas emissions by 47%, compared to a conventional building.
Before leaving China, the Italian Minister visited the Sino-Italian Environment and Energy-efficient Building (SIEEB) at Tsinghua University and gave a lecture on the topic “Sustainable Development is a Common Responsibility”. In her speech, Mrs Prestigiacomo recalled the important efforts of China with regard to sustainable growth and enhanced environmental awareness. She highlighted the fact that Italy, through the 10-year Sino-Italian Cooperation Program for Environmental Protection, has contributed to China's achievements and has pointed the way for technological cooperation as a key tool for facing global environmental challenges.

VIU Dean and TEN Center President in Beijing and Shanghai

VIU's Dean Stefano Micelli and the TEN Center President Ignazio Musu visited China for an official visit to open the CASS Training Program 2009/2010 and to meet the Chinese institutions participating in the VIU/IMELS Advanced Training Program. Coordination meetings between TEN Center President Ignazio Musu and the representatives of MEP, NDRC, MOST, and the municipalities of Beijing and Tianjin took place in Beijing to plan the 2010 capacity building activities.
At Tsinghua University, Dean Micelli and Vice President Jining Chen signed a new MoU for admitting VIU Globalization Program students at Tsinghua University to study globalization and the environment. Dean Micelli also met the two VIU students of the Globalization Program who have just started a three-month course at the Italy-China Chamber of Commerce in Beijing. In Shanghai, Tongji University stated his readiness to admit more VIU students than the two presently there, while the EPB Shanghai welcomed VIU to confirm the topics for the 2010 training course.
The VIU delegation had the honor of visiting the EXPO sites in Shanghai and to plan the Italian Pavilion's activities as part of the SICP celebrations.

Establishment of the Legislative and Management Framework on Contaminated Sites is Under Way

In 2006, the former SEPA (State Environmental Protection Administration of China) drafted the Guideline for Risk Assessment of Contaminated Sites to strengthen the environmental management of soil in the process of reusing and further developing contaminated sites, to protect the health of human beings and ecological systems, and to regulate the risk assessment of contaminated sites.
This guideline is an important component of a series of environmental policies on soil protection and management. Currently three important guidelines are being developed, including those on contaminated site field investigation, monitoring, and clean-up and remediation technologies. They formulate the major legislative and management framework on contaminated sites.
The risk assessment work is based on the field investigation findings and the assessment results will provide the scientific basis for remediation and clean up. The guidelines regulate the work of hazard identification, exposure evaluation, toxicity evaluation, site characterization, and remediation levels etc.
Comments and suggestions from relevant departments, scientific institutions, universities and enterprises are now being collected for the (draft) guidelines which are expected to be officially promulgated next year.

Contaminated Site Cleanups: Valuing the Costs and the Benefits

Margherita Turvani, University IUAV of Venice

Introduction

The European legislation is guided by the "polluter pays" principle, implying both that the polluter may be required to invest in equipment and processes that reach environmental standards and, as in the Directive on Environmental Liability, that responsibility for the cost of the cleanup is placed on those parties who have contributed to creating the contamination problem. This system should both prevent future contamination problems and provide financing for any required remediation. In practice, the application of such a principle in the case of contaminated sites has shown faults: the burden of environmental liability and the costs of complying with the environmental legislation have discouraged large scale and diffused cleanups. In addition to the EU Directive on Environmental Liability, several other EU directives support the prevention and cleanup of soil contamination. They include:

_ the EU Waste Framework Directive (2006/12/EC) which addresses the prevention of pollution from waste and defines any contaminated materials, substances or products resulting from remedial action with respect to land as waste;

_ the EU Water Framework Directive (2000/60/EC) which requires a program of measures, including those addressing the land contamination that causes water pollution, be in effect by 2015;

_ the EU Groundwater Directive (2002/118/EC) which aims to prevent or limit pollutants, including those from historical land contamination, from entering into groundwater;

_ the EU Directive on Nitrates from Agricultural Sources (91/676/EEC) which addresses the environmental impacts of excess nitrogen;

_ the EU Integrated Pollution Prevention and Control Directive (2008/1/EC) which requires permits for new or existing industrial and agricultural activities with a high pollution potential.

More recently, the EU Soil Protection Strategy (2006) should produce a new, complete and homogeneous regulatory framework for EU countries, including specific provisions for contaminated sites.

Given the extreme diffusion of contaminated sites in all European countries, much discussion focuses on the huge amount of money which will be necessary to accomplish the goals of human safety and environmental protection; a major concern is the large number of "orphan sites", where it is impossible in practice to enforce the liability principle and for which the financial burden remains a public one.

In this note I introduce the issue of contaminated sites in terms of diffusion of the problem and I introduce a social perspective in the calculation of the main costs and benefits of their remediation.

Site Remediation and Its Costs

Remediation of contaminated sites is attractive because it reduces risks to human health and ecological systems, and brings a host of potential social and economic benefits. Whether enforcement-based (as is typical of most recent contaminated site programs) or reliant on collaboration between private entities (such as developers and investors, residents, and governments), addressing the problem of contaminated sites is judged to be an important component of sustainable urban regeneration and has important implications in terms of economic development and quality of life for residents and workers.

More than 300,000 potentially contaminated sites have been identified in Western Europe; the estimated number for the whole of Europe is much larger, while in Italy the estimated number is 15,000. Cleaning up contaminated sites is a costly exercise. However, in the countries where estimates are possible, the annual expenditure remains relatively small, on average representing 2% of the estimated costs necessary for the overall management of contaminated sites. Although most of the countries in Europe have legislation which applies the "polluter-pays" principle to the management of contaminated sites, large sums of public money still fund remediation activities: on average 35% of the total expenditure. This is primarily due to the limited nature of the legislation, especially in the case of the remediation of historical contamination, where many of the legally responsible polluters no longer exist, cannot be identified or are insolvent. The proportion of public funds used to clean up contaminated sites ranges from 100% in the Czech Republic, the Former Yugoslav Republic of Macedonia and Spain, to a minimum of approximately 7% in France, where a large proportion of funds comes from the private sector (Fig.1).

The Italian National Priority List

The largest and most contaminated areas in Italy have been identified and they have been put on a National Priority List (Fig.2). For these sites, the realization and much of the funding of remediation projects is a national responsibility, while for other sites responsibilities are placed at the local level.
The diffusion of contaminated sites within Italy, and the extent of contamination in the soil, the water and the groundwater constitute a menace to the population's health and to the ecosystem.
The laws work both to limit this menace in the future and to address ongoing problems by identifying the responsible parties and at least in part solving the problem of finding adequate financial resources for cleanups. Contaminated site remediation is an expensive priority for governments but the removal of polluting substances from the soil can contribute numerous benefits, among them the improvement of environmental quality and the reduction of risks posed to human health, not to mention the possibility of reusing the polluting substances for productive or recreational use.
An appropriate tool to evaluate the social balance for these kinds of projects is to apply the framework of a cost-benefit analysis to enhance the efficacy and efficiency of their implementation. This practice may also help communities to understand the potential beneficial impacts of site remediation and sustain the implementation of public policies for the environmental cleanup of contaminated sites.

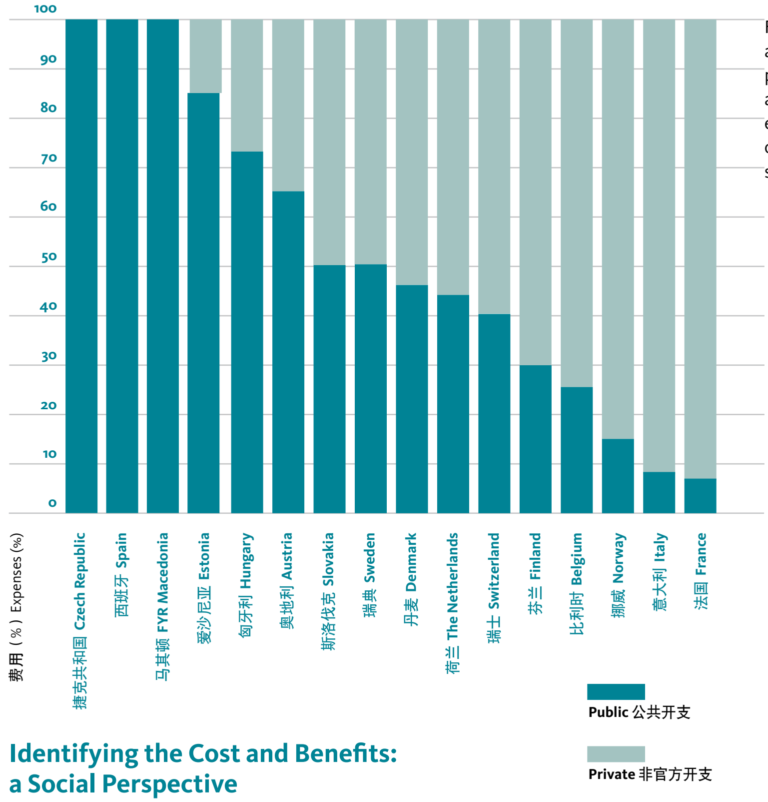


Fig.1. Estimated allocation of public and private expenditure for contaminated sites in Europe

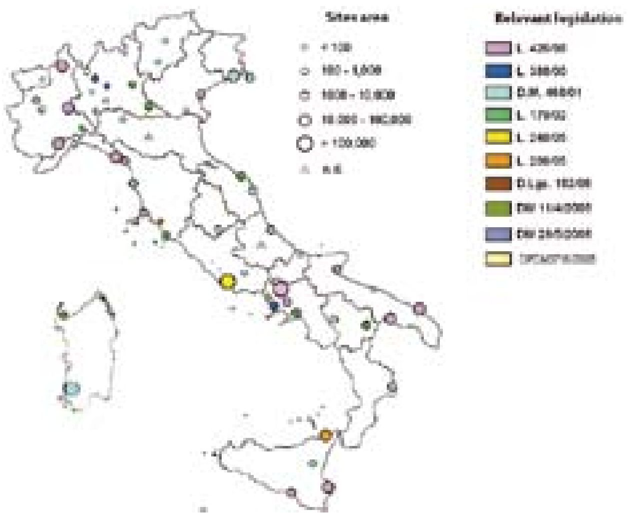
Identifying the Cost and Benefits: a Social Perspective

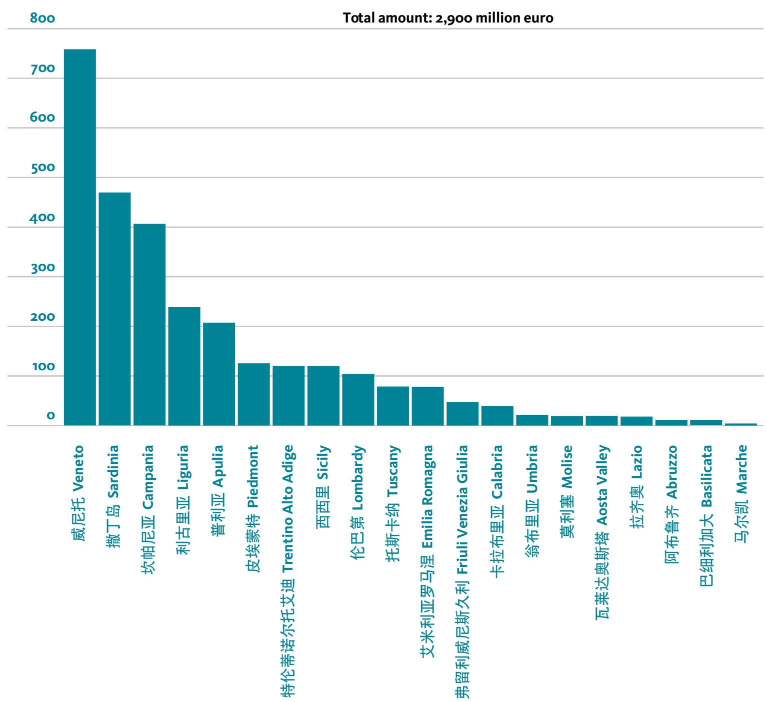
A comprehensive cost-benefit analysis of a cleanup project must take into account various factors that can have positive or negative impacts on the value of the property, on the wellbeing of the communities involved, and on the natural environment.
In Italy, the calculation of direct costs of NPL site cleanups amounts to almost three million euros (Fig. 3). The direct costs of this sort of project depends on the type and severity of contamination (extent and mobility of contaminants), the characteristics of the site itself (location and historical conditions of the area), the choice of the best available cleanup technology, and finally, the administrative and legal costs relative to the acquisition, cleaning and recovery of contaminated sites. Data about real situations is rather scarce but we may refer to data provided by the Italian Ministry of Economic Development as a benchmark.
The characterization costs of contaminated industrial land in Italy range between 12,000 euros/ha to 30,000 euros/ha, according to the complexity and co-presence of contaminants; for contamination at sea the range is between 500 euros/ha to 2,500 euros/ha. Information regarding Italy's cleanup costs is particularly scarce

and it varies very much according to techniques and site-specific situations. We can report as reference data, however, information from the European experience where cleanup costs range between 250,000 euros/ha to 750,000 euros/ha according to their complexity. These costs generally do not take into account indirect costs such as, for example, those due to the delay in using the land because the remediation process is slow, and those related to the uncertainty and the higher transaction costs of the project. Brownfield redevelopment projects pose higher levels of uncertainty for decision makers than would occur with any other property investments. The higher risks refer to the site assessments needed to determine the type and extent of the pollutants, remediation planning, the execution of remediation plans, and the environmental damage liability claims associated with the past pollution of a site. Any one of these factors imply higher transaction costs that involve an array of measurements, information, bargaining and contracting costs other than those associated with the acquisition of unpolluted land. Other costs incurred due to contamination are related to the difficulties in accessing the necessary funding for the development project. Thus, although many contaminated sites have the potential to become profitable business ventures that generate new activities and new employment opportunities, public investment is often needed to catalyze private funds. This is because the cleanup interventions are very expensive - and financial capital is hard to find - and there is a considerable delay between the initial investment and the time in which the site can be productively used again. Accordingly, the role of the public sector in these projects is to design the cleanup strategy, to pinpoint the appropriate areas for development, to initiate the remediation process, to provide funding and to encourage the participation of the private sector. Economists recommend that the costs should be compared with the benefits of the project (Fig. 4). Thus, focusing on the positive side of the brownfields remediation and redevelopment process, the main benefits can be grouped into three broad categories: environmental benefits, social benefits and economic benefits.
The environmental benefits include the reduction of developmental pressure on greenfields sites, protection of public health and safety, protection of groundwater resources, protection and recycling of soil resources, restoration of former landscapes, and the establishment of new areas deemed to have ecological value. Restoring natural areas may also entail "non-use benefits", such as the option to conserve a natural resource to use

Fig. 2. Diffusion and extension (ha) of contaminated sites on the National Priority List in Italy

Fig. 3. Estimated costs of remediation projects by region (thousands of euros)





Benefits and costs of remediation and reuse of Brownfields

Benefit
_ Protects human health and the environment;
_ increases the tax base in the local area;
_ restores or replaces dilapidated buildings and facilities;
_ strengthens central economic centers;
_ creates jobs;
_ utilizes existing infrastructure;
_ encourages inner city investment;
_ reduces suburban sprawl;
_ prevents the spread of the contaminants.

Costs
The direct costs depend on:
_ type and severity of contamination (extent, mobility of contaminants);
_ characteristics of the site itself (location and historical conditions of the area);
_ choice of the best available cleanup technology;
_ administrative and legal costs cleaning and recovery of contaminated sites.

Indirect costs:
_ costs due to the delay in using the land because the remediation process is slow;
_ costs related to the uncertainty and the higher transaction cost of the project.

in the future, and the satisfaction of knowing that natural resources are preserved for future generations. The social benefits include, among others, the renewal of urban cores, an improved quality of life, the elimination or reduction of negative social stigmas associated with the affected communities by revitalizing them, and a reduced fear of ill health, environmental deterioration and loss of property values in these communities. Furthermore, these areas will attract domestic and foreign investment, reconstructing the tax base for local government by increasing employment (short-term and long-term jobs), boosting the local economy and property values. Other benefits include increasing the utilization of, and reinvestment in, existing municipal services; the development of remediation/decontamination technology; and the exploitation of existing infrastructure systems.

Conclusions

Contaminated site remediation is one of the most urgent policies for local and national governments: yet, site remediation implies large public financing and therefore it needs the support of public and private sectors, together with the consensus of communities. Communicating the beneficial effects of cleaning up contaminated sites to the public may be decisive for the effectiveness and success of a remediation policy.

For further reading on applying CBA see:
_ Alberini A., Longo A., Tonin S., Trombetta F., Turvani M. (2005). Economic Incentives in Brownfield Remediation and Redevelopment: Evidence from Surveys of Developers. *Regional Science and Urban Economics*, 35, 327-351.
_ Alberini A., Tonin S., Turvani M., Chiabai A. (2007). Paying for Permanence: Public Preferences for Contaminated Site Cleanup. *Journal of Risk and Uncertainty*, 35, 155-178.
_ Turvani M., Tonin S. (2008). Brownfield Remediation and Reuse: an Opportunity for Sustainable Development, in C. Clini, I. Musu, M. L. Gullino, (ed.) *Sustainable Development and Environment Management: Experiences and Case Studies*, Heidelberg, Springer.
_ Turvani M., Tonin S., Alberini A., Chiabai A. (2009). Public Policies for Contaminated Site Cleanup: Evidence from a Survey of the Italian Public, *International Journal of Environmental Technology and Management*, Vol. 11, Nos. 1/2/3, pp 68-87.
For data on Italy see:
_ Agenzia per la Protezione dell'Ambiente e per i servizi Tecnici (APAT). (2007). *Annuario dei dati ambientali* 2007. Roma: APAT.
For EU Contaminated sites strategy see:
_ www.ec.europa.eu/environment/soil/index.htm
_ www.englishpartnerships.co.uk/brownfieldstrategy.htm
_ www.cabernet.org.uk/
For USA contaminated sites strategy see:
_ www.epa.gov/smartgrowth/brownfields.htm
_ www.epa.gov/swerosps/bf/

Fig. 4. Main costs and benefits of the remediation project

Porto Marghera and VEGA Case Studies

Giorgio Mattiello, VEGA – Venice Science & Technology Science Park
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Porto Marghera area extends for approximately 3,500 hectares and is centred on an industrial district, about 1,300 hectares wide, located at the border of the Lagoon of Venice, Italy.
Its industrialization dates back to 1920, but the maximum expansion occurred in the '60s-'70s (approx. 35,000 employees). Most of the area, originally a salt marsh, was reclaimed using dredged sediment and industrial waste to build up new plants. It is served by a commercial and industrial port inside the lagoon and connected to the sea through two artificial channels.
In the past, the pool of factories included chemical and petrochemical plants (refineries, and cracking, chlorine compounds and fibres, etc.), power plants, and productions of steal, aluminium and fertilizers. Today, petrochemical, chemical, power plants, shipyards and oil refineries are still active, while part of the site is under dismission.
According to the Italian national law 426/1998, Porto Marghera is the largest site out of the 50 contaminated sites of national interest. Site characterization revealed heavy and widely spread contamination, mostly due to the presence of polycyclic aromatic hydrocarbons (PAHs), amines, dioxins (PCDD/F), halogenated organic compounds (PCBs, HCB, etc.) and metals (As, Hg, Cd, Pb, Zn, etc.) in both soil and groundwater.
In 1998, an agreement (Program Agreement on chemical productions) among local and national authorities, representatives of the industries located in the site, and labour unions, was signed to support sustainable management of the whole industrial site of Porto Marghera. The agreement aimed at rehabilitating the area and at encouraging industrial investment as a new stimulus for economy and employment.
The agreement also included the definition of a Master Plan for the Porto Marghera site, ensuring an integrated approach to the whole area. The Master Plan set up the management actions for the rehabilitation of this large site, encompassing all the remediation activities, the logistical aspects, and the intervention costs.
The Master Plan defined site characterization measures, with a uniform analytical protocol, 1,200 drillings out of which more than 500 piezometers. 7 hydrogeological enclosures were created in the area, in consideration of hydrogeological conditions, treatment options and economical sustainability. Around 6,400,000 m^3 of sediment were dredged, out of which 1,500,000 were treated as toxic and hazardous materials. For soil and groundwater contamination, priority interventions areas were defined, and specific remediation technologies were applied, including biological treatments, multi-phase-extraction, *in situ* chemical oxidation, electro-chemical remediation technology, soil vapour extraction, air sparging. Costs of remediation of the industrial contaminated soil and other activities were impressive, of the order of hundreds millions euros.
The current remediation activities undertaken on the contaminated site of national interest is shown in the figure (Fig.1).
Due to the complexity of the area and the ambitious

Fig.1. The current remediation activities undertaken on the contaminated site of national interest is shown in the following figure

objectives set for its remediation, dedicated softwares, mainly spatial applications, for the analysis and management of the Porto Marghera area were developed. Specifically, DESYRE (DEcision Support sYstem for the REqualification of contaminated sites), a spatial Decision Support System, was developed to address the integrated management and remediation of large contaminated sites, and of Porto Marghera first of all. The system helps decision makers in the analysis of social and economic benefits and constraints, in the site characterization, risk assessment, selection of best available technologies and creation of different remediation scenarios to be evaluated and compared. DESYRE was developed by Consorzio Venezia Ricerche (www.veneziaricerche.it), one of the companies included in the VEGA Park area, and active in the field of applied research for environment, cultural heritage, new materials and ICT technologies.
In this framework VEGA site has been the first case to demonstrate the possibility of qualifying again a dismissed industrial area in Porto Marghera. This territorial cleaning process has been the first in such an area after which it was declared (Law n.426, 9.12.1998) of national interest in relation to pollution. Two of the four areas already indicated by the Municipality of Venice Land Use Planning to host the Science and Technology Park have been directly involved with the VEGA Company. VEGA 1 and VEGA 2 cleaning operations started in 1996 and in 1999, respectively. The Italian legislation for the polluted soils cleaning was approved in 1997 and only two years later all the implementation rules have been approved. Due to this fact, in 1996 it has been compulsory to agree with the Venice Province Administration's procedures regarding cleaning activities. It established a special Technical Commission which prepared the Authorization Decree referring to the soil qualities the Regional Legislation already enforced at that time by a few Italian regions (Piedmont, Lombardy, Tuscany and Emilia-Romagna) to plan and to implement projects for cleaning operations, safety measures and environmental recovery of contaminated sites. The Decree was approved on September 16, 1996.

VEGA 1 Area Cleaning Activities

The industrial activities previously performed on the site (*ca*. 10 hectars) until 1986 have deeply compromised the environmental quality of the area and in 1996 the buildings already contained materials related to the past activities of sulphuric acid production, fertilizer production and copper extraction from the pyrite ashes. In 1995, a sampling campaign of the soil was done through drilling and core sampling reaching a depth between 3 and 12 meters, confirming heavy metals contamination due to the presence of lead (Pb), arsenic (As), copper (Cu), zinc (Zn) and partially cadmium (Cd). No significant presence of organic chemicals has been found.
In 1997, the war residuals' cleaning was completed with the assistance of a special section of the Italian Army. In 1998, the collection of the site soil and its division into different contaminated sections was started. The building and the underground pipelines demolition revealed the presence of asbestos. The cleaning of this material has been done by a specialized company team under the authorization and control of the Local Health Authority. The high iron and low heavy metals pyrite ashes have been stored in a warehouse before being sold to cement factories. The low iron and high heavy metals level pyrite ashes have been stored on site. In the meantime, two big pools have been prepared to host them which are both partially over and below street level. The filling of the pools has been done by "packing" the ashes with 2 mm thick foils of high density polyethylene (HDPE). The foils are certified by the manufacturer for the seal and they have been sealed on site by certified operators. A foil of nonwoven fabric has been added to the "packages". A layer of clay covered by a layer of clean soil have been distributed over the ashes "packages" taking care to create a drainage net to avoid rain water stagnation. The soil layer has been utilized to create two green (grass and bushes) gardens. The cleaning activities steps have been certified by the Venice Province Administration. Moreover the 1996 Venice Province Administration Decree indicated how to periodically test the water table present a few meters below the pools with a set of analysis to control the risk of a "packages" leaking.

VEGA 2 Area Cleaning Activities

The area (*ca*. 9 hectars) has been a big tanks site utilized until 1991 and was left contaminated by hydrocarbons. The 29 tanks, already existing on the site, were used to contain gasoline and oil derivatives. The operations to fill trucks and train cars, and the relative casual spills, have been the origin of soil contamination.
In 1997, a sampling campaign of the soil was done through drilling and core sampling reaching a depth of 5 meters, testing the presence of heavy metals and hydrocarbons, and confirming hydrocarbons contamination reaching levels over 1,000 ppm. It has

been necessary to clean 34,000 tons of soil and to avoid transporting this huge amount of soil outside the area an innovative cleaning procedure has been selected. A bioremediation technique has been performed and with soil mixed with heterotroph organisms four biopiles 110 meters long, 20 meters wide and 3 meters high have been created after the tanks demolition. The biopiles have been equipped with pipes for water and air to keep the environment safe for the microorganism activity. An additional pipe system has been created to drain the biopiles and the system has been connected to a waste water cleaning plant built on site. The biopiles have been covered with foils of high density polyethylene (HDPE) to avoid, in particular during the summertime, the dust release. To reach the hydrocarbons level permitted by national legislation (less than 500 ppm) has been necessary a bioremediation period of three years and the cleaning activities steps have been certified by the Venice Province Administration.
The ability and effectiveness of the DESYRE software in addressing the rehabilitation of complex contaminated sites, the experience maturated in the successful management of the Porto Marghera site and the success related to the VEGA 1 and VEGA 2 cleaning activities have been transferred to China, in order to support the efforts of the Chinese institutions in contaminated areas assessment and management. In fact, two projects were recently performed among Italian and Chinese institutions. VEGA and Consorzio Venezia Ricerche and the Chinese Research Academy of Environmental Sciences started in 2007 a collaboration for the application of the DESYRE software to a Chinese case study. With an initial training session of Chinese researchers in Venice, in order to get knowledge and practise of the software, the application to the case-study was performed in Beijing by Chinese experts under the coordination of Italian researchers. A follow up of this collaboration is the project SIERRA (Sino-Italian Environmental Regional Risk Assessment) aiming at defining a risk-based framework for the sustainable management of contaminated sites in China, including inventory of sites, risk assessment and remediation technology strategies.

Status Quo of China's Control of Contaminated Sites and Opportunities and Challenges for Sino-Italian Cooperation

Li Fasheng, Chinese Research Academy of Environmental Sciences

Over the last three decades, the Chinese economy has boomed thanks to the Reform and Open-up Policy. On the other hand, various industrial activities have made site contamination an increasingly serious problem. In China, heavy chemical industries, petroleum production, mining/metallurgy, chemical production and use, and the piling and disposal of industrial wastes are the main contributors to site contamination. Because of the economic boom, industrial restructure and the expansion and rearrangement of the urban layout, some enterprises formerly based in the center or populous areas of the city are relocated after a merger, transfer or when they close down, leaving vast areas of contaminated sites. Industrial enterprises cause pollution to the surrounding environment and soil in the following ways: 1) inappropriate use of production materials and intermediate products; 2) release of environmental pollutants during production;
3) settlement of atmospheric pollutants (particles) on the ground surface; 4) leakage from underground pipelines and 5) inappropriate piling of industrial solid wastes. Although the relocation of enterprises causing pollution puts an end to environmental pollution, pollution of the soil and underground water will remain for a long time. Take Beijing for example. Over the last five years, the city (under the leadership and supervision of the Environmental Protection Bureau of the Municipal Government) has relocated or disciplined 197 enterprises that caused serious pollution and public outcry, and 141 of them (including Beijing Coking and Chemical Plant) have since been shut down and relocated. It is noteworthy that the Site Environment Control International Cooperation Project implemented by the Italian Ministry of Environment, Land and Sea and the Beijing Environmental Protection Bureau, as part of the Sino-Italian Cooperation Program for Environmental Protection (using the former site of the relocated Beijing Coking and Chemical Plant as a case study), promoted the progress of site environment control in the capital Beijing, making it a pioneer in site environment regulation nationwide.

1. Status Quo of China's Management of Contaminated Sites and Existing Problems

The commencement of major scientific research and production practices aimed at preventing and treating soil pollution in the 1960s has allowed China to achieve remarkable results in research and development for almost four decades. However, our efforts to control the soil (site) environment lag far behind our efforts to control atmospheric pollution and water environment pollution, as a comprehensive and systematic supervision system doesn't exist and a standard system for contaminated sites is yet to be established.
On the other hand, China's site contamination issue is a complex one, characterized by a vast cumulative amount of various types of contaminants. At present, China faces the following problems in the control of contaminated sites:

(1) Lack of Basic Information on Contaminated Sites

According to the experience of other countries, the control of contaminated sites consists of several phases: site survey; site categorization; the creation of a list of national prioritized contaminated sites; building and development of site risk assessment technologies; site restoration; and determining control objectives. China has not yet conducted any systematic survey identifying contaminated sites nationwide. As a result, the overall situation of site contamination is unclear, and no accurate statistical data is available for the coverage, nature or degree of contamination, the exact number of contaminated sites and the types of contaminants. In China, site contamination is largely neglected - not even included in the regular contamination detection - due to the absence of a sound site contamination monitoring and detection system and a national monitoring and detection network. We know little about the history and *status quo* of site contamination in China and are unable to monitor and detect all target contaminants, especially organic contaminants, in the absence of a dynamic management system for site information.

(2) Insufficient Awareness of the Environmental Behaviors of Site Contaminants and Their Hazards

At present, in the absence of research on the transfer, conversion and nature of site contaminants, we know little about the pathogenic mechanism and toxicology of contaminants. We lack knowledge of the means of exposure in the contamination chain and give inadequate attention to the pollution of underground water around the site and to the biological process of contamination and enrichment/magnification in the food chain.

(3) Absence of a Complete Risk Assessment System

China faces some difficulties in assessing the risks posed by contaminated sites, especially in the absence of laws and regulations (in terms of risk assessment and technical guidelines or principles for site risk assessment as a benchmark). Over the years, no standard other than the Environmental Quality Standard for Soil, which was enacted in 1995, has been applied to national soil quality assessment. This standard is largely inapplicable to the assessment of industrial contaminated sites as it only gives reference values for some elements and two organic contaminants.

(4) Absence of Legal Bases and Technical Standards for Renovating Contaminated Sites

In China, a complete legal system for soil contamination prevention is yet to be established. Despite a series of pollution prevention laws, namely the Air Pollution Prevention Law, the Water Pollution Prevention Law and the Solid Waste Pollution Prevention Law, a law dedicated to the prevention of soil contamination remains absent, which is an impediment to the supervision and law enforcement of contaminated sites. On the other hand, China is yet to formulate a renovation specification or technical guide for contaminated sites, as well as the mechanism and *criteria* for assessing the renovation of contaminated sites.

(5) Absence of a Financing Plan for the Restoration of Contaminated Sites

China does not have any financing plans dedicated to the restoration of contaminated sites, such as the US Superfund and the Brown Land Restoration Fund. For contaminated sites with determined responsibilities or those with undetermined responsibilities, dedicated financial resources for their restoration and comprehensive treatment are unavailable.

2. Development of China’s Contaminated Sites Standard System

China still lags far behind developed countries in the regulation of contaminated sites and contamination control and there is a demand for the following priorities to be addressed currently and in the future:

(1) Establishing a National Database of Contaminated Sites

It is necessary to conduct a comprehensive and systematic survey of contaminated sites nationwide: to determine their type and distribution and identify the history and causes of the contaminated sites; to learn the actual conditions of sites, verify the authenticity of the information gathered and determine the current conditions of contaminated sites; to clean up and analyze survey data and draw a preliminary conclusion on the possibility of site contamination and means of contamination (such as soil, ground surface water, sediments, underground water and the atmosphere); to determine the types of contaminants and the degree/scope of contamination; to determine the current conditions of contaminated sites and gain a thorough understanding of the contaminated sites nationwide by analyzing the sources of contaminants; and to establish a database (national archive) and information management system for the basic information on contaminated sites.

(2) Establishing a Monitoring System for Contaminated Sites to Create an Effective Model for Site Identification and Registration

It is necessary to improve the national soil environment quality monitoring network, establish a contaminated sites monitoring system, determine a list of prioritized soil contaminants (blacklist), formulate and release the Technical Specifications for Contaminated Sites Environment Monitoring and unify and standardize survey techniques and methods for contaminated sites and establish a dynamic information and registration system on contaminated sites to acquire information and data on contaminated sites from multiple sources.

(3) Establishing a Risk Assessment System on Contaminated Sites and Formulating Relevant Technical Standards

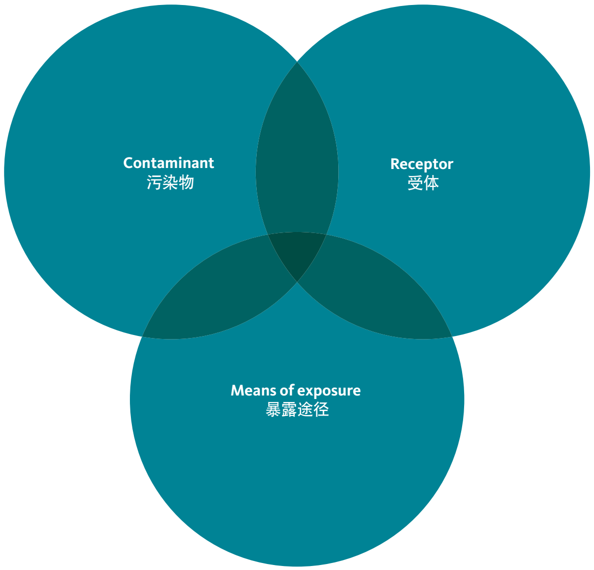
The assessment of health risks posed by contaminated sites serves as an important basis for the restoration and treatment of sites, including the collection of data on site contaminants/receptor/exposure, exposure assessment, toxicity assessment and risk representation (see Fig. 1 for the basic concepts relating to site risks). It is necessary to select typical contaminated sites for trial assessments of health risks, based on the *status quo* of research on the health risks of contaminated sites and existing problems in China. It is also necessary to import or develop models and methods applicable to the assessment of risks posed by contaminated sites in China to lay a foundation for the formulation of technical guidelines on the assessment of site environment risks. It is important to continue studies into the relevant mechanisms for risk assessment, especially the characteristics of exposure to the population of China.

(4) Selecting Practical Restoration Technologies and Creating Demonstration Restoration Projects

The restoration of contaminated sites is a process involving multiple technologies. Different technologies and techniques are selected and combined for the restoration of different contaminated sites based on the nature of contaminants, land reutilization methods, difficulty of implementation and operation /maintenance costs. It is necessary to formulate and promulgate technical guidelines for the restoration of contaminated sites, select technologies to restore contaminated sites and conduct research into an expert decision-making system and encourage the development and application of innovative technologies for site restoration according to the needs of the state for environmental management.

(5) Establishing Sound Laws and Regulations on Contaminated Sites and Improving the Contaminated Site Control System

For the regulation of contaminated sites, special legislation, or a revised improvement to the existing laws and regulations is required focusing on prevention at the expense of the contaminator.
Fines or compensation measures should be formulated



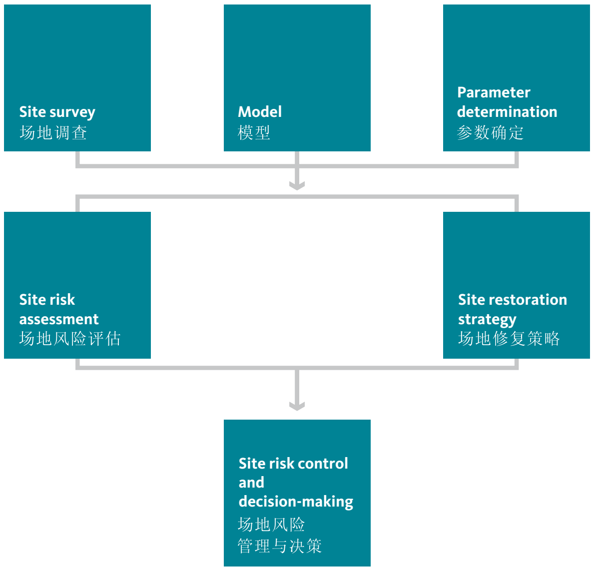


Fig.1. Basic concepts and decision-making procedures in contaminated sites risks and risk control. The pollutants in the figure refer to poisonous and hazardous substances that pose a potential threat to human health; the receptor refers to the population; means of exposure refers to skin contact, ingestion and breathing. All three factors must coexist to form risks

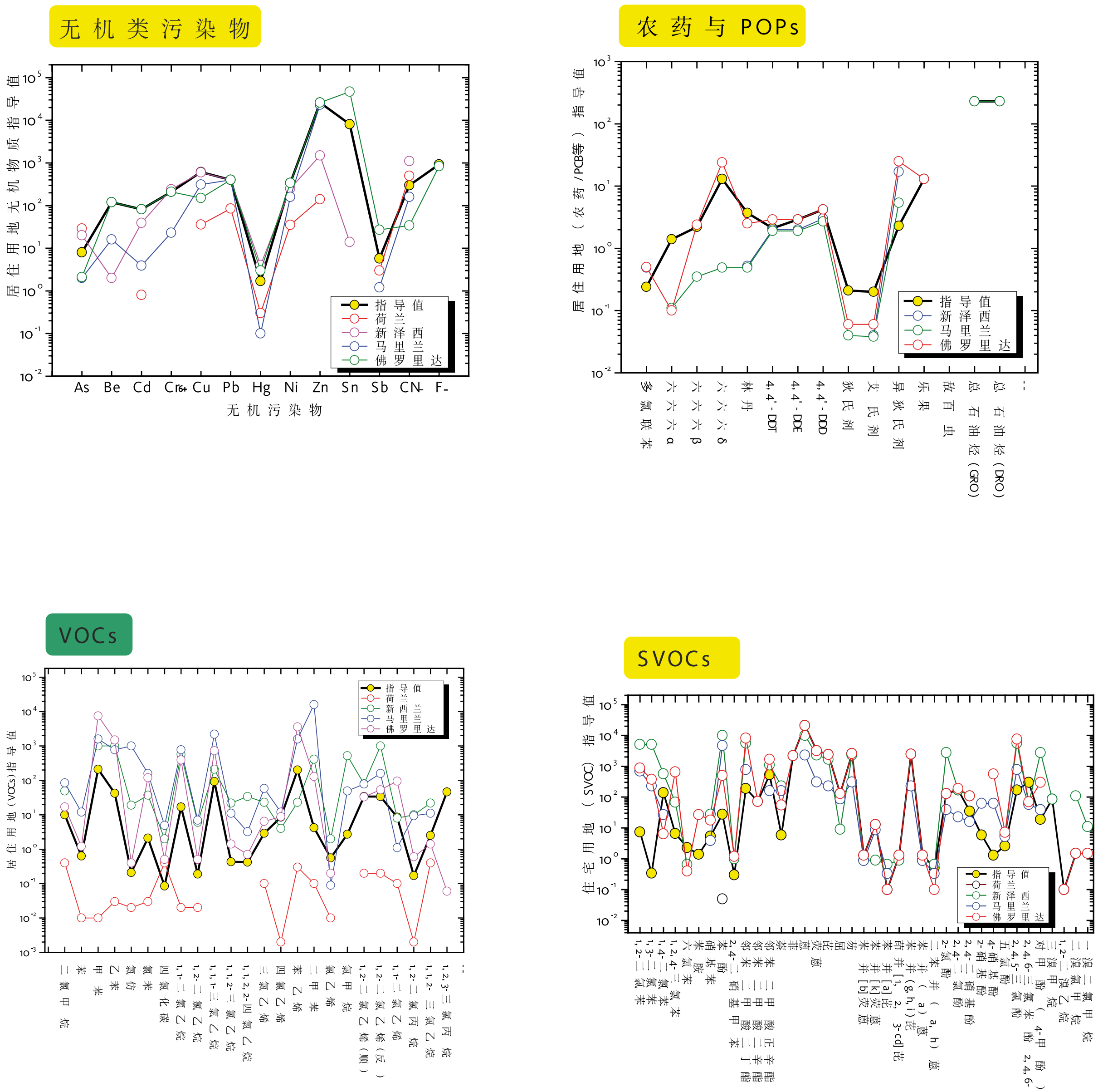


Fig. 2. Comparison between the screening values *criteria* for risk assessment of industrial sites in Beijing developed under the support of the Sino-Italian International Cooperation Program and the standard values of relevant countries in the world.

for the restoration and treatment of contaminated sites. Enterprises contributing to contamination by discharging hazardous wastes should be fined to form a special fund, or charged an extra pollution tax to form a reserved tax. Competent state authorities should then use the funds to form the China Superfund for restoring contaminated sites with undetermined responsibility, and a special fund for handling site emergencies, so as to promote sustainable development in the restoration of sites, soil and underground water.

(6) Strengthening Public Participation and Risk Communication

A social consultation and risk communication mechanism is necessary, with increased promotion and education in the control of contaminated sites through the internet and news media to improve the awareness of the general public of the danger of contaminated sites and encourage voluntary prevention of site contamination. Thus, the public will be more active with regard to site management, decision making and exercising their right to information on contaminated sites (which will be open and transparent to the public).

3. Sino-Italian Cooperation, Opportunities and Challenges

(1) Sino-Italian Cooperation with Regard to Contaminated Site Control and Outcomes

China and Italy have carried out effective cooperation in the control of contaminated sites. Over the last three years, Italy has conducted research into technologies for site environment regulation in cooperation with the Beijing Municipal Environmental Protection Bureau, using the former site of the Beijing Coking and Chemical Plant as a case study, and promoted the progress of Beijing in technical standards and regulations for the prevention and treatment of contaminated sites. The Chinese Academy of Environmental Sciences (a major participator) led the research and formulated the Beijing *Criteria* for Assessment of Industrial Sites Risks, guided by the leaders of the Beijing Municipal Environmental Protection Bureau and Italian experts, and made more comparisons with the guide values of relevant countries during standard formulation (Fig. 2). These values, for which opinions are being solicited, will be implemented at the end of 2009 and play their role in the supervision of contaminated sites in Beijing.

(2) Sino-Italian Bilateral Cooperation Project Managerial and Technical Support for the Restoration of Contaminated Sites and Soil, and the Prospect for Cooperation between the Chinese and Italian Governments in the Control of Contaminated Sites

Under the leadership of the Sino-Italian Project Office, the Foreign Cooperation Center for Environmental Protection (as part of the Ministry of Environmental Protection) and the Chinese Research Academy of Environmental Sciences is conducting research into the project Managerial and Technical Support for the Restoration of Contaminated Sites and Soil, a bilateral cooperation project between the Chinese and Italian governments, which is aimed at promoting the development of laws, regulations and standards for site supervision in China. Italy, with its advanced expertise and management techniques in the control of contaminated sites, is expected to achieve remarkable results in the formulation of site control procedures and standards through the international cooperation project.

Clean-up of Contaminated Sites, Standards, Guidelines and Test Cases in the Beijing Municipality

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Introduction

Many industrial sites have been shut down or are under decommission in China, especially in the Beijing area.
The strong economic growth and the rapid urban expansion around industrial districts are strong driving forces for the shutdown, relocation and re-conversion/redevelopment of industrial plants. These dismissed sites are very often characterized by the presence of pollutants in the subsoil (underground soil and groundwater), which represent a threat for the future development of the areas, especially as they are mostly devoted to urban expansion.
The comprehensive process of remediation of contaminated sites - with specific reference to dismissed industrial sites due for redevelopment in urban areas - is quite complex, encompassing a relatively large number of functions, subjects and needs in line with Chinese principles on property, and the general Chinese commercial and industrial framework.
A complete regulatory system for contaminated site cleanup has not yet been adopted in China; therefore, Beijing municipality has put in place a coordinated effort to develop a complete set of compulsory regulations which would appropriately deal with subsoil contamination in industrial sites, assuring adequate protection of human health and the ecosystem and allowing new development on contaminated sites, contributing to harmonious economic growth.
In recent years, Italy has developed extensive experience in the cleanup of contaminated sites, both on the regulatory (with a progressive refinement of regulations in the last years) and on the technological/applicative side.
On this basis, and within the framework of their cooperation in the environmental sector, the Beijing Municipal Environmental Protection Bureau (BMEPB) and the Italian Ministry for the Environment, Land and Sea (IMELS) have agreed to a comprehensive cooperation program between the Chinese professionals in charge and qualified Italian experts. It is based on a typical "learning by doing" process for the BMEPB's structure and for the related public organizations, aimed at putting in place a regulatory system for the Beijing municipality on the contaminated sites and at building a strong capacity within BMEPB to manage these problems.
This cooperative effort aimed at preparing and proposing an applicable system of standards and guidelines for the cleanup of contaminated soils, the protection of human health and ecosystems and to allow the economic recovery of contaminated sites, was successfully completed.
It provided BMEPB with very valuable results, in terms of both support for regulation development and greater knowledge, and the capacity for management of both technical and administrative issues on contaminated sites.

Regulatory Issues

The scope of the project, carried out by the Italian engineering firm D'Appolonia S.p.A., in cooperation with ISAF S.r.l., was to support the BMEPB in the definition of a new regulatory framework for the Beijing municipality; to cover the management of polluted industrial sites and define the procedures and requirements to be complied with during environmental investigations; and to plan remedial interventions.
Although most Chinese environmental policies and regulations go back many years, only recently more specific attention has been devoted to soil pollution problems and its cleanup, especially with reference to new development of dismissed industrial sites.
These dismissed sites are almost always characterized by the presence of pollutants in the subsoil (underground soil and groundwater), which represent a threat for the future development of the areas, especially as they are mostly devoted to urban expansion. In the last decade, the State Environmental Protection Administration (SEPA), now known as the Ministry of Environmental Protection (MEP),

Fig.1. First database for contaminated site Management installed in BMEPB offices in 2009

Fig.2 The planning, execution e evolution at the results of the preliminary subsoil and groundwater investigation activities

issued several general guidance documents; however, a complete regulatory system for contaminated site cleanup has not been adopted yet in China; therefore, the Beijing municipality has put in place a coordinated effort to develop a complete set of compulsory regulations to deal with subsoil contamination at industrial sites, assuring adequate protection of human health and the ecosystem and allowing new development on remediated sites, contributing to harmonious economic growth.
On such bases, BMEPB and IMELS have agreed to a comprehensive project aimed at putting in place a regulatory system for the Beijing municipality on the contaminated sites and building a strong capacity within BMEPB to manage these problems.
In order to achieve this goal, a step-by-step regulatory framework elaboration process has been developed by:
_ providing BMEPB with an extensive review of the local and international regulations;
_ selecting, in agreement with BMEPB, the list of contaminants of concern for the potentially contaminated industrial sites in the Beijing area;
_ defining a first set of regulatory limits (Threshold Level Concentrations and Maximum Level Concentrations) for each of the contaminants of concern, selected to be used as reference limits within the site investigation phases;
_ reviewing the BMEPB Draft Regulation on the Development and Utilization of Beijing Municipal Contaminated Sites (Interim Measures for Administration of Environmental Protection).
By accomplishing the above-listed step by step process, the Beijing Municipality has been provided with a first draft regulation consistently reviewed in order to meet internationally-applicable standards, and although it provides a schematic and simplified approach, it is a useful tool for contaminated site management.

Contaminated Site Management Guidelines and Database

Through a detailed reviewing process of the existing contaminated sites and under elaborate guidelines on contaminated site management, input based on the experience gathered by D'Appolonia and ISAF on remediation projects performed worldwide has been provided to the BMEPB.
Specifically, the cooperative effort was aimed at reviewing and elaborating on:
_ guidelines on site assessment and risk analysis;
_ guidelines on remediated site closure;
_ guidelines on contaminated soil landfilling.
The guidelines on site assessment and risk analysis were intended as a tool to guide all possible subjects (in particular, public institutions) involved in contaminated site investigation projects. These guidelines were developed in order to meet the international standard approach to site investigation and subsequent risk analysis (with particular reference to the U.S. EPA standardized approach).
The guidelines on remediated site closure were intended to provide a tool to be used by the certifying bodies (e.g. BMEPB, connected research institutes or nominated third parties) in the evaluation of the results of a remedial intervention at a contaminated site.
Finally, the guidelines on contaminated soil landfilling were prepared to respond to the specific need of the BMEPB to select and design landfill sites exclusively dedicated to the disposal of contaminated soil (whenever remedial intervention aimed at reducing

the contamination is not considered technically and /or economically feasible).
Additionally, in order to provide the BMEPB with a management tool for the contaminated sites the guidelines must:
_ summarize in a schematic way, all the information available relevant to the site history, physical features and environmental characteristics;
_ provide a log of all the administrative acts and ownership data;
_ provide a step-by-step log of all the field data and documents collected during the site assessment and remediation activities.
D'Appolonia, in cooperation with ISAF, has been in charge of the development, of the first database for contaminated sites management which is on a server for the clients' configuration. The database was installed and operational in BMEPB offices at the beginning of 2009. It is currently uploaded with all of the data collected during the site assessment activities performed within the project (Fig.1).

Contaminated Site Management Test Cases

A number of pilot site investigational and remedial test cases have been implemented in order to support and train the BMEPB team in planning and performing site investigation activities, as well as in evaluating the investigation results. Most of these activities have been carried out in cooperation with the Beijing Municipal Research Institute for Environmental Protection (BMRIEP).
In addition to their purpose in regard to training and capacity building, the implemented test cases provide continual feedback to the Beijing municipality on the applicability of the regulations and guidelines being developed within the regulatory and technical framework.
The activities carried out include:
_ the completion of investigation activities, the evaluation of characterization results (including the definition of remedial goals through risk analysis) and the preliminary selection of remedial options for the Beijing Coke and Chemical Works (BCCW) dismissed Coking plant;
_ the planning, execution and evaluation of the results of the preliminary subsoil and groundwater investigation activities at the Beijing Keeven Aviation Instrument Co. Surface Process Branch Plant, the No. 2 Auxiliary Agent Works of Beijing Eastern Petrochemical Co., Ltd, and the Organic Chemical Plant of Beijing Eastern Petrochemical Co., Ltd (Fig.2);
_ the planning, execution and evaluation of the results of the geotechnical and environmental investigations performed at the Doudian candidate site for the construction of a new contaminated soil landfill.
The joint effort in the investigations carried out at selected test case sites:
_ provided a conclusive and reliable assessment of BCCW site contamination, to be used both to start the conceptual design of the remedial interventions and/ or to plan for additional yet focused environmental investigations into the areas still affected (during the project) by the presence of abandoned processing units;
_ provided a preliminary characterization of three new sites which identified the need for further investigation and additional study into the natural background concentrations in the Beijing area (Fig 2);
_ introduced the BMEPB/BMRIEP teams (and connected institutes) to the best international practices in field investigations by performing joint field sessions and providing detailed field sampling plans, focused both on the activities to be performed, and the quality assurance requirements;
_ improved the knowledge and know-how of the BMRIEP team and connected institutes in the planning and carrying out of field investigation, as well as in the evaluation of site assessment results and performing risk analysis.
Among the possible test case sites, the dismissed Beijing Coke and Chemical Works (BCCW) plant was identified by BMEPB as being of primary interest and was subsequently adopted as the first operative working platform to calibrate and check the provided guidelines.

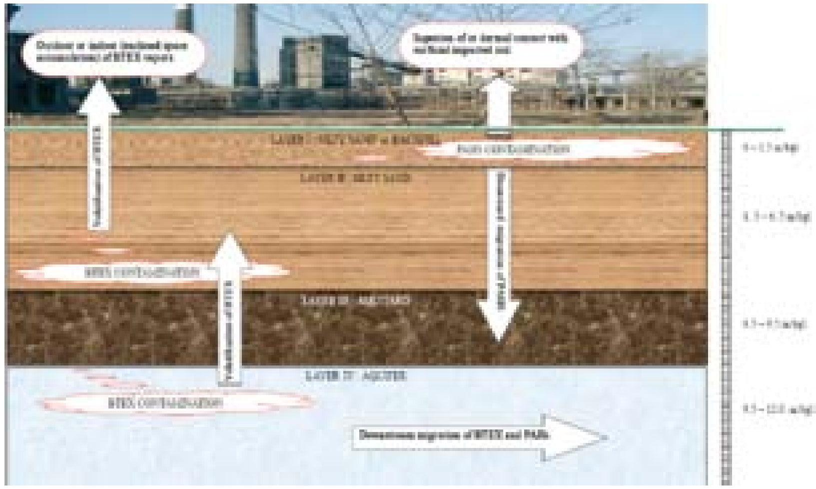

Fig.3 The lateral and vertical extension of subsoil contamination at the site, in both surficial and deep layers, by the presence of Monocyclic Aromatics (BTEX) and Polynuclear Aromatics Hydrocarbons (PAHs), in excess of the adopted reference threshold level concentrations (U.S. EPA Soil Screening Level for Residential Areas)

A remarkable portion of the work of this widespread project was therefore addressed in the investigation and remediation design of the BCCW site.
Located in the Fatou area beyond the 4^{th} East Ring Road, in the Chaoyang District of Beijing, the BCCW coke plant was in operation from 1959 to 2006 (when the site was closed). During its operation it provided: coal, gas and quality coke, for both domestic and industrial use, as the main final products of coal carbonization and gasification processes; chemical products such as ammonium sulphate, light benzene, industrial naphthalene, anthracene, bitumen and phenols also derived from end-products of the treatment of by-products associated with gas purification procedures.
The activities conducted at the site, and in general within the BCCW site framework, included several different tasks such as:
_ the review of past investigations and the identification of the data gaps;
_ the selection of the best available technologies for site investigation at a preliminary phase, aimed at contractors auditing and subsequently proposing short-term corrective measures and targets to be accomplished during the additional proposed investigation;
_ the planning and execution of the field subsoil and groundwater sampling and laboratory analyses campaign;
_ the elaboration and definition of data for site remediation goals and needs by performing a site specific risk analysis;
_ the identification of the applicable remedial options for the site.
In terms of site assessment results, the cooperative effort concluded on the definition of:
_ the lateral and vertical extension of subsoil contamination at the site[1], in both surficial and deep layers, by the presence of Monocyclic Aromatics (BTEX) and Polynuclear Aromatics Hydrocarbons (PAHs), in excess of the adopted reference threshold level concentrations (U.S. EPA Soil Screening Level for Residential Areas) (Fig.3);
_ the site conceptual model and the relevant remediation goals in terms of residual concentrations allowable at the site, as derived by the performed risk analysis for each possible land use scenario;
_ the applicable remedial technologies, mainly identified in:
· *ex situ* or on-site thermal desorption of surficial contaminated soil, following excavation;
· *in situ* soil vapor extraction and/or bioventing of deep contaminated layers;
_ the identification of the data gaps and follow-up steps to be accomplished within the BCCW site remediation process, including proposed integrative investigations following the removal of the process units still in place, and the laboratory and pilot tests to be performed to evaluate the effectiveness of the selected remedial options.

Concluding Remarks

The activities illustrated in the previous sections are an excellent example of successful teamwork between Chinese and Italian experts within the framework of the Sino-Italian cooperation.
First of all, a widely recognized improvement among Sino-Italian team members in the knowledge on contaminated sites management was achieved, starting from the earlier investigation phases, up to the selection of the most appropriate remedial technologies.
The cooperative effort provided an initial contribution to the developmental process for a new regulatory framework, aimed at providing the Beijing municipality with an up-to-date regulation covering all contaminated site management topics; based on the project outcomes, a number of guidelines were worked out that were suitable to be used as technical standard reference during the upcoming environmental investigation and remediation projects, both by public and private sector operators.
In addition, the BMEPB/BMRIEP team members gained an increased knowledge of the technical issues relevant to the execution and interpretation of site investigation activities, through field activities performed both at the BCCW site and the three additional investigated sites.
Finally, following the project a well-integrated team of Chinese and Italian experts was established, able to proficiently carry out new projects in the field of contaminated site investigation and remediation.

Notes

1 With the exception of the areas still covered by the abandoned plants and processing units.

PCB Contaminated Sites in China. A Risk Assessment/Risk Management Approach

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Lu Chenggang, Chinese Ministry for Environmental Protection

A “zero” concentration for all soil pollutants would be the best option, if feasible. By zooming into this apparently simple consideration, and more specifically, looking into the practical meanings of “zero”, “soil pollutant” and “feasible”, several complex issues suddenly appear.
First of all, “zero” is a relative concept in the physical world. The concentration of a pollutant in the environment is never null: in the best case, its value is lower than the resolution of the best analytical method. However, the “safe” concentration of a pollutant in the environment may be well below the sensitivity of the available analytical technology, where “available” means the technology available “where” and “when” necessary. For this reason, improving analytical capability is not only a research issue, but is first of all a basic tool for reducing the health risk for the population and for protecting the environment.
Secondly, what is a soil pollutant? Pollutant, from the ancient Latin words “*pollutio, polluere*” means something able to “contaminate, tarnish or profane” something else. However, when talking about soil pollution, a basic distinction should be made from substances naturally present in soil (for instance, some heavy metals), and those that have been artificially introduced (for instance, PCBs which are a completely artificial class of substances). In the first case, it should be remembered that some compounds which may be deadly at high concentration might, on the other hand, represent an essential constituent of soil at low or very low concentration. Soil is a complex ecosystem resulting in the mutual adaptation of living organisms, climate and the physical and chemical structure of its components: for this reason, for several compounds it is not always possible to individuate a universally “safe” concentration. Another important aspect when talking about soil pollutants concerns their “environmental behavior”. On the basis of a few chemical features, compounds may present a full range of very different environmental behaviors: substances which are soluble in water, once dispersed in soil, may be easily transported into groundwater, or may enter water bodies after surface runoff; persistent and bio-accumulable substances, which cannot be easily biodegraded (like PCBs), may progressively build up in soil and living organisms also as a result of transference from other environmental media; biodegradable substances (like several hydrocarbon derivatives) may enter a complex equilibrium with the microorganism and electron acceptors naturally present in soil[1]; volatile compounds may migrate from soil to the atmosphere, representing a source for human inhalation exposure. Understanding the environmental behavior of pollutants is a fundamental issue when performing the risk assessment of contaminated sites or designing soil cleanup strategy.
Another important aspect is the type of toxicity of each compound: some compounds may present a toxicity threshold under which no adverse effect should be expected; for others, like carcinogenic or mutagenic compounds, a threshold cannot be defined and zero should be considered the only completely safe concentration. Because the “zero” option is not feasible, the only option for non-threshold compounds is to adopt a concentration representing the minimum incremental risk acceptable and reasonably feasible.
Thirdly, feasibility is a concept lying in that gray zone among science and policy. Feasibility is not a scientific concept, but is based on scientific considerations. Several considerations usually lead to the “feasibility analysis” of a certain decontamination level: a balance consisting of the need to preserve human health and the environment without paying unbearable social or economical costs; the availability of the needed technologies; cost effectiveness; priority; enforceability;

and monitorability. In the case of soil contamination, issues like land use and land price, resettlement costs and public acceptance of the decontamination technologies may play a very important role in the feasibility evaluation.
Thus, notwithstanding that everybody would agree on the introductory sentence, at the same time it is certainly evident that the establishment of the correct "safe level" of a concentration of a soil pollutant is only possible as a result of complex activity requiring sound technological and scientific capability (risk assessment), integrated with an unbiased feasibility analysis (risk management).

A short introduction to PCBs. PCBs, a class of chlorinated compounds produced in 1929, are essentially biphenyl molecules with a different degree (from 1 to 10) of chlorine substitutions. On the basis of the number and position of the chlorine atoms, 209 different PCB isomers are possible, characterized by a broad range of toxicity and environmental behavior. A detailed analysis of the toxicity of PCBs and of their environmental behavior is beyond the scope of this paper (detailed information can be found in the US EPA reassessment[2]); however some key aspects can be recalled to clarify the rationale underlying the risk assessment of PCB contaminated soil:
1) **PCBs are artificial substances**. The PCB molecule is not naturally produced in any metabolic pathway of living organisms. This means that the "natural" PCB background concentration in soil should be zero; unfortunately, due to the long-range transport and accumulation capability of these molecules, even the most pristine environment contains a measurable amount of PCBs.
2) **PCBs are persistent**, recalcitrant to biodegradation, highly bio-accumulable, strongly lipophilic, and have a low solubility in water and low vapor pressure; however these features vary with the degree of chlorination-less chlorinated congeners being more soluble in water, more volatile, more biodegradable and less lipophilic than the more chlorinated congeners.
3) **PCBs have been mainly produced and used as mixtures** of congeners. Mixtures have been placed on the market under different trade names; for instance in China the most common mixtures were PCB3 and PCB5, whilst in the USA the PCB mixtures have been marketed under the trade name of Aroclor followed by a 4-digit number. The first two digits generally refer to the number of carbon atoms in the biphenyl skeleton (for PCBs this is 12), the second two numbers indicate the percentage of chlorine by mass in the mixture. Thus, PCBs have been released in the environment mainly as mixtures.
4) **Different PCB congeners behave differently in the environment**. In the environment, PCBs also occur as mixtures of congeners, with a composition differing significantly from those of the original released mixture. This is because after being released into the environment, the composition of PCB mixtures changes over time, due to the different mobility, chemical transformation and preferential bioaccumulation of the different congeners.
5) **PCBs are toxic**. They have been known to cause a variety of adverse health effects. PCBs have been shown to cause cancer in animals. PCBs have also been shown to cause a number of serious non-cancer health effects in animals, including effects on the immune system, reproductive system, nervous system, endocrine system and other health effects. Studies in humans provide supportive evidence for potential carcinogenic and non-carcinogenic effects of PCBs. The different health effects of PCBs may be interrelated, as alterations in one system may have significant implications for the other systems of the body.
6) **Different PCB congeners have a different toxicity**. For this reason, the overall concentration of PCBs in the environmental media is usually not a good risk indicator: the same concentration value may actually lead to very different toxicity, depending on the relative concentration of low chlorinated or non dioxin-like PCBs (low toxicity) or high chlorinated or dioxin-like PCBs (very high toxicity) in the mixture. The toxicity indicator on which there is the greatest agreement is the TEq (toxicity equivalent index) which provides a relative indication of the toxicity of each PCB congener compared to the toxicity of the most toxic dioxin (the 2, 3, 7, 8 TCDD). The TEq index values for PCBs were reassessed in 2005 [3].
7) **PCB disposal may generate dioxins if not properly performed**. PCB mixtures may contain a certain amount of dioxins; moreover, the disposal of PCBs by means of a thermal process, if not performed adequately, may lead to a secondary formation of dioxins.
Legislation concerning PCBs in China and the need for a risk-based soil clean-up standard for PCBs.
As testified by the history of its legislation, China has been struggling to eliminate the risk associated with

Table 1: PCB soil quality criteria in several countries

Country (norm)	Soil quality criteria or land use			
USA (Risk Based Concentration in soil)			Residential 0.14	Industrial 1.4
Canada (Soil Quality Guidelines)		Agricultural 0.5	Residential /Parkland 1.3	Commercial/ Industrial 33
Europe (Member states rules as from the classification proposed by JRC)	Negligible	Warning	Potentially unacceptable (residential)	Potentially unacceptable (Industrial)
Czech Republic	0.02	2.5		
The Netherlands	0.02			
Italy		0.06		5
Finland		0.1	0.5	5
Austria		0.2		
Sweden		4		
Germany		0.8		
Belgium			0.9	10.4
Lithuania			0.1	
Poland			0.55	2.75
Spain			0.08	0.8

PCBs for a long time. The first legislation prohibiting the use of PCBs for the manufacturing power capacitors was dated March 1974[4]. In August 1979[5], new legislation was introduced which prohibited the importation of electric PCB equipment. Due to the lack of specific technical rules, after enforcing these regulations, existing PCB capacitors were dismantled or sold as scrap material (for instance, for the recovery of copper) with very bad consequences for the environment and human health[6].
It was only in 1990[7] that the former State Environmental Protection Agency (now MEP) addressed the problem by issuing the "Circular on Strengthening Management on Abandoned PCB Power Capacitors" which strictly prohibited recycling and dismantling waste PCB power capacitors. However, the first regulation attempting to solve the problem of PCB pollution in a systematic way was the 1991[8] "Regulations on Prevention of Environmental Pollution of Electrical Equipment Containing Polychlorinated Biphenyl and its Wastes". This regulation is still the most important regulation in China concerning PCB management and disposal and applies to "electrical transformers and capacitors containing PCBs and other related equipment and the waste containing PCBs from these" and regulates "the use of PCB containing equipment and the post -abandonment collection, storage, transportation, disposal and installation of related wastes containing PCBs, as well as pollution management and import/ export actions." Unfortunately this regulation also has several shortcomings, which have been recognized in the recently issued NIP; among them, one of the most important is the lack of a suitable clean-up standard value for PCB contaminated soil. Actually, the 1991 regulation established the following control quality standard for PCBs in soil:

_ low PCB contaminated soil, from 50 mg/kg to 500 mg /kg (to be disposed by landfilling);
_ high PCB contaminated soil, over 500 mg/kg (to be disposed by incineration) (Tab. 1).

It is evident that the above concentration limits should be considered as action values (above which some actions should be undertaken) rather than risk-based limit values. In Table 1, soil quality limit values derived in the USA and Europe on the basis of a risk assessment/ risk management procedure are shown. All of these limits (including the limits for industrial soils) are well below the 50ppm value. For this reason, the need for the Chinese NIP to develop a risk based quality *criteria* for the concentration of PCBs in soil has been established as a priority for the nation.

PCB contaminated sites in China. A recent reassessment of the number of PCB capacitors abandoned or disposed of in China is in the order of 450,000 pieces[9]. In the best case, these capacitors were stored in temporary storage facilities (underground concrete coffins or in caves) that were designed to last for a limited period of time, in compliance with the 1991 legislation.[10] That regulation also established that "*The construction of centralized and seal up for safekeeping warehouse must undergo an environmental impact assessment.*" (article 12) and "*Centralized and sealed up temporary storage sites must set up management rules, adopt effective safety and health protection countermeasures, install evident signals of toxic danger and periodically carry out parameter monitoring of any possible effects at storage sites.* (article 13)". The same regulation also established a detailed reporting system among SEPA, the Ministry of Energy and the different level EPBs, thus theoretically a significant amount of information should still be available. Unfortunately, tracks of most of these storage sites have been lost; in several cases the landfilling of PCB contaminated wastes has been performed with such poor technologies and environmental protection measures that it has resulted in serious releases of PCBs in the environment and contamination of soil. As a result, in China now there are several PCBs contaminated sites, of which only a small fraction has been discovered. There is very little information concerning the number of PCB contaminated sites in Chinese provinces. In Zhejiang, which is the demonstration province for China PCB demo project[11], a preliminary inventory based on site visits, historical records and interviews led to nearly 60 PCB contaminated sites. With the technical and financial support of the Italian government, an extensive geophysical survey of these sites has been performed[12], leading to a confirmed number of 35 PCB contaminated sites. Several PCB contaminated sites are being discovered all over China: in Shiyan (Hubei province) four coffins containing more than 5,000 PCBs were buried by the Dongfeng Automotive Company in 1984; these capacitors are now being removed and disposed of under the responsibility and at the cost of that company. The objective of the ongoing PCB demo project is to decontaminate all of the sites in Zhejiang province. It is not an easy task, as several questions should be addressed: What is the clean-up target? What is the rationale for taking into account the specific Chinese conditions? What are the best options for clean-up, storage, and final disposal? How should technological needs be balanced with costs and public acceptance? To address these issues, the work performed under the PCB demo project basically followed two main approaches, both based on triangular risk assessment /risk reduction/risk management:

1) through the development of risk-based standards based on PCB contaminated soil in China;
2) by addressing the overall risk deriving from PCB disposal.

Development of a risk-based standard for PCB contaminated soil in China. In general, the process for setting a clean-up limit value is the result of two separate but convergent processes: risk assessment, which is a science-based process, and risk management, which is a process based on social, economical and technological considerations (Fig. 1). The risk assessment process will individuate, only on the basis of scientific considerations, the limit value corresponding to the "acceptable" risk; whilst the risk management process will evaluate only if that value is feasible from the point of view of available technologies, social acceptability, priority and costs etc. It is actually the risk management process which will have "the last word" in setting up the limit; however, once a scientific agreement has been achieved on a certain risk-based limit value, that limit should not be modified only on the basis of feasibility considerations. In other words, if the risk-based limit cannot be considered "feasible", several other options should be considered before deciding to decrease the level of protection: changing clean-up options, reviewing land-use classification, adopting different kinds of limits based on priority setting, or even refining the risk assessment assumptions. Only after all possible alternative options

Table 2: Range of concentrations corresponding to the acceptable incremental risk

Land Uses	Agricultural		Residential		Commercial/Industrial	
	min	max	min	max	min	max
Aroclor 1016	1.8	230	3.9	299	38	966
Aroclor 1242	0.003	0.8	0.2	9.7	1.1	33
Aroclor 1248	0.010	2.8	0.4	10.0	1.3	34
Aroclor 1254	0.020	5.4	0.4	10.0	1.3	34

have been considered, if what is considered "acceptable" from a scientific point of view is not feasible, the level of protection should be decreased, at the same time introducing the necessary countermeasures.
In China, the clean-up limit value for PCB contaminated sites has been studied by Nanjing University[13] within the framework of the PCB demo project, following technical specification jointly proposed by CIO and the project CTA. The methodology was based on the following main steps:
_ analysis of land use in contaminated sites, based on the inventory of the PCB contaminated site by the Zhejiang EPB. Five sites were classified as agricultural, four sites as residential, eight sites as commercial, and eight sites were located under highways or in cemetery areas;
_ human exposure: the following groups were identified as being exposed: farmers, adults and children.
The following exposure pathways were considered relevant: oral ingestion of contaminated soil; dermal contact from contaminated soil; particulate inhalation of contaminated soil; vapor inhalation of contaminated soil; vegetable consumption of contaminated soil.
This last exposure pathway is considered relevant only for agricultural land use;
_ development of exposure models for each exposure pathway; taking into account exposure frequency, duration, physiological parameters for the children and adults exposed; averaging the time for carcinogenic and non-carcinogenic effects; transfer rate from contaminated soil to vegetables, etc;
_ estimation of PCB concentrations in environmental media, on the basis of a partition model, and an US EPA model for indoor air; and adopting a transfer rate model for calculating PCB concentrations in vegetables;
_ aroclor based approach: Nanjing University adopted an Aroclor (mixture) based approach both for estimating toxicity parameters and for estimating physical/chemical parameters. Aroclor 1016, 1242, 1248 and 1254 were considered;
_ acceptable cancer risk: the incremental cancer risk assumed as acceptable in the study was assumed to be 1 over 100,000. A sensitivity analysis was performed considering values ranging from $1x10^{-4}$ (less conservative) to $1x10^{-6}$ (more conservative);
_ a cost comparison against the existing 50 ppm value was performed to calculate the clean-up cost of the different limit values proposed, considering only one technology (thermal desorption) and cost schemes based on the USA experience.
In Table 2, the range of proposed limit values (taking into account the coupled effect of organic carbon content in soil and different acceptable cancer risk) is reported (Tab. 2).
On the basis of a weighted average of the above value, technology availability and cost considerations, and by comparison with the limit values adopted in western countries, the following clean up control values (in PCB) were proposed by Nanjing University for Zhejiang province: agricultural soil: 0.5 mg/kg; residential soil: 1.5 mg/kg; commercial/industrial soil: 14 mg/kg.
The proposed approach is unavoidably affected by some shortcomings: 1) evaluating risk on the basis of Aroclor mixtures may be misleading, as once released into the environment, the pattern of concentration of PCB congeners may be significantly different from that of Aroclor; moreover, in China the mixture used for PCB capacitors is probably different from Aroclor mixtures; 2) important exposure pathways (such as soil, animal fat and consumption of meat and milk) have not been considered; 3) the feasibility analysis is based on cost and technological information from western countries. However, this study is probably the

first attempt in China to derive a clean-up limit value based on a formal integration of risk assessment and risk management, and the proposed values are in line with values adopted in western countries. A further (nationwide) refinement of the clean-up values could be performed once congeners specific concentration data, clean-up costs, social issues (for instance resettlement needs) are available from the clean-up demonstration activity being conducted in Zhejiang.

Addressing the overall risk deriving from disposal of PCBs. Another important aspect when evaluating the clean-up of POPs contaminated sites is the residual risk deriving from all the clean up actions performed.

In the PCB demo project, highly contaminated PCB wastes will be transported from Zhejiang to be disposed of in the hazardous waste facility located in Xinmin (Shenyang, Liaoning province). This incinerator has been upgraded with a state-of-the-art air pollution control system, and equipped with a storage facility, a PCB waste pre-treatment train and an online control system. The safe operation of this incinerator is not only required by Chinese regulations, but is also one of the pre-requisites of the PCB demo project. The fulfillment of BAT concentration value (less than 0.1 ngTEq/Nm^3 of PCDD/PCDFs in the flue gas emitted by the incinerator) represents a mandatory pre-condition for the continuation of the project.[14] But, beside the concentration of PCBs and dioxins in the incinerator flue gas, the residual risk is the result of: 1) the PCBs released during the PCB waste pre-treatment processes; 2) the PCB and dioxin concentration in the different processed residues (fly ash, bottom ash, sludge); 3) the level of exposure of the workers in charge of site clean up, transportation, waste pre-treatment and incineration.

Moreover, a key aspect is to ascertain the overall amount of PCBs and PCDD/Fs released, not in terms of absolute concentrations, but in terms of TEq (toxicity equivalent). For this reason, to guarantee effective risk reduction of the whole process, the following actions have been performed within the PCB demo project: 1) the adoption of adequate Personal Protection Equipment for operators and on-site training to use this equipment; 2) the definition and adoption of safe procedures for storage, transport and pre-treatment; 3) performing a trial burn test on PCB oil, PCB contaminated wastes, and PCB capacitors; and 4) measuring both the DRE (Destruction and Removal Efficiency) and the DE (Destruction Efficiency) in terms of PCB and TEq. This trial burn test was completed in September 2009; the laboratory results concerning PCBs, PCDD/Fs and heavy metals in PCB wastes, incinerator flue gas and incineration residues (which would demonstrate the capability of the incinerator to fulfil the Stockholm Convention requirements and to fulfill national requirements) are still pending at the time of writing this article.

If successful, a significant step toward the destruction of PCBs affecting our common environment would be accomplished, thanks to an important example of a joint effort of international cooperation.

This trial burn test was completed in September 2009[15]; the preliminary laboratory results concerning PCBs and PCDD/Fs in incinerator flue gas and incineration residues demonstrated the capability of the incinerator to fulfil not only the national requirements, but

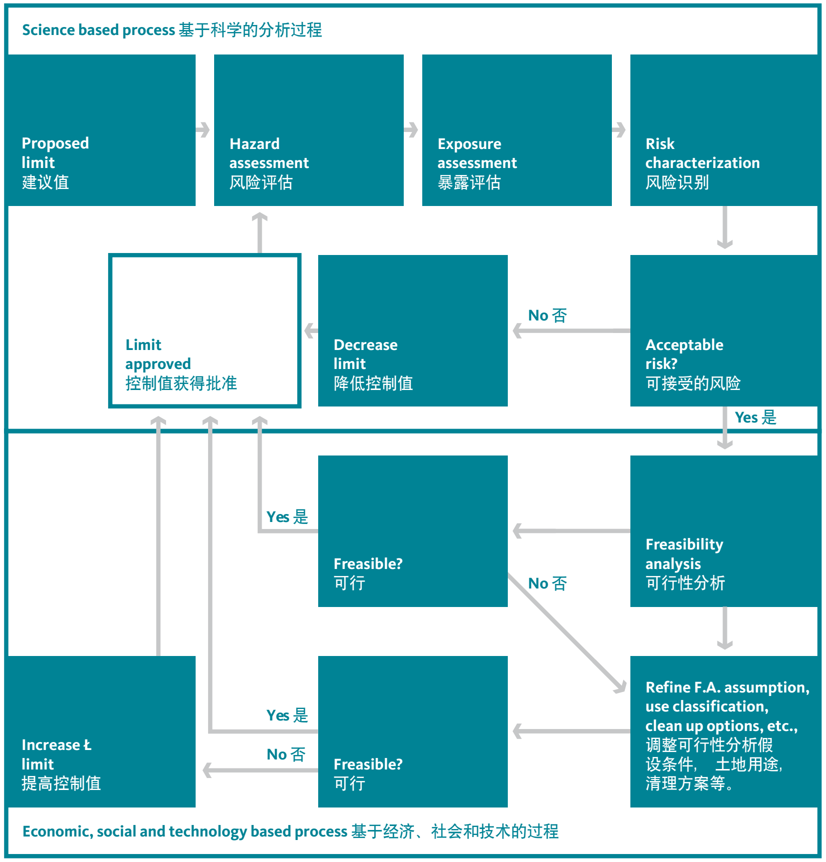

Fig. 1: The risk assessment/risk management process

even the more stringent Stockholm Convention requirements. This success, representing a significant step toward the destruction of PCBs affecting our common environment, has been achieved thanks to this important example of international cooperation.

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The “Venezia-Porto Marghera” Site of National Interest

Laura Fincato, Deputy Mayor for Strategic planning, Territorial planning, Territorial safety and the Environment

One of the most important, potentially contaminated Sites of National Interest is located a short distance from the historical centre of Venice, on the outskirts of the urban center of Mestre and situated alongside the Venice lagoon.
The “Venezia-Porto Marghera” site (S.I.N.) covers a surface area of 5,769 hectares, and is composed of:
_ 2,300 ha of marshland;
_ 513 ha of industrial canals;
_ 1,846 ha of industrial areas;
_ 400 ha agricultural areas;
_ 700 ha urban areas (commercial, residential & parks).
All of the areas which fall within the S.I.N. perimeter, as stipulated by the Italian Ministry for the Environment, Land and Sea Decree, (23rd of February, 2000) are subject to obligatory characterization, emergency regulation where necessary, land and groundwater cleanup, and mandatory compensation in the case of environmental damage.
The Ministry of the Environment is responsible for overseeing the administrative procedures of the S.I.N, operating through a network of national agreements and services.
Adopting the Program Agreement on the Chemistry of Porto Marghera, signed in October 1998 and revised in December 2000, this project was amended in 2004 to create the Master Plan for the reclamation of the Porto Marghera site.
Coordinated by the Veneto Region and the Venice Municipality, the project defined the strategic planning required for the environmental remediation and urban renewal – an essential starting point for productive reuse and functional redevelopment – with estimated implementation costs at a total of 3 billion euro and a 10 year timeline for its realization.
With the ratification of the Master Plan, the S.I.N. reclamation program has quickly progressed following three main strategies:
_ land cleanup, in order to guarantee the necessary conditions for the present reuse of the territory (residential and park areas) and productive reuse of the area. Currently, more than 90% of the S.I.N. interventions are in place whilst 49% of the industrial area is involved in cleanup projects or have been definitively secured and are, therefore, immediately viable, or have already been completed (12%);
_ cleanup and securing of the underground waters, together with the marginalization of the canals in the industrial zone, where 40km have so far been completed and another 14km are planned;
_ cleanup of the industrial canals and marshland.
This has been carried out through the Moranzani Framework Agreement, which is technically and economically compatible in dealing with polluted sediments, in relation to the complete recuperation of navigation conditions in the industrial canals.
In addition to this, the remediation of the landscape, environment, waterways and thoroughfare on a significant part of municipal territory.
The Municipality of Venice has strongly participated in the promotion and direct realization of remediation policies in the area, and places the urban regeneration of municipal territory amongst its priorities.
Amid the recent environmental remediation initiatives to have completed, are the areas which are now VEGA – the science and technology park of Venice and the Parco di San Giuliano, approximately 70 hectares, which have undergone redevelopment and have been restored to the community, constituting not only a local attraction, but also as trigger for urban regeneration projects in the surrounding area
Currently, the Venice Municipality, in order to accelerate urban renewal and cleanup programs of the S.I.N., and in accordance with the Ministry of the Environment, is organizing an intervention project

regarding the characterization and remediation of all of the urban areas (residential, parks, public and private) within the site of national interest (approx 600 ha). The interventions are carried out by the Venice Municipality with no foreseen costs for land owners, thanks to specific agreements between the municipal administration and the Ministry of the Environment. More than 22 million euro (bylaw: 135/2005) have been allocated to complete this project, to which the remediation interventions carried out by the municipal administration through their own monitored agencies on 44 hectares of industrial areas must also be added.

This section is written by the Chinese participants in the trainings in Italy.
We hope hereby to provide the Newsletter readers with an authentic flavour of the training experience.

National Development and Reform Commission
Capacity Building on Climate Change
Italy, March 7–21, 2009

1 The impression of the training program: not only the contents of the training, but also the trainees' comments on what they experienced and what it meant to them to participate in it.

Feedback:

1) Field visit/study is useful and impressive (e.g. the MOSE Project).
2) It is productive to have one-week's training at Venice International University to avoid frequent travelling.
3) To give the trainees a better understanding of the applications of different fields with regard to climate change, Italian bureaus specially organized site inspections of the mobile barrier system which is currently under construction and aims to protect the Venetian Lagoon, and the Agricultural Innovation Lab of the University of Turin. We witnessed that the Venetian Provincial Government is trying to reduce the impact of climate change on the natural ecology by implementing a defense project to protect the lagoon via artificially–controlled mobile gates, and to find out the influence of climate change on the growth of certain crops and the related pests and diseases by simulating the concentration of greenhouse gases in the atmosphere.
4) In general, we have learnt a great deal, but we thought the lectures were a bit too easy for us. We would have liked higher-level lectures to be delivered based on assessed training needs. More field visits would have been preferred.

2 What has been learned through the training, with the emphasis on creating links between the lectures/visits and China's specific issues?

Feedback:

1) The Italian government has long been engaged in addressing the environment and climate change and has yielded good results from which we can learn. For example, most hotels and public places in Italy use energy-saving lamps which are not yet widely used in China.
2) European countries have been playing a leading role in the global action against climate change. Based on the 1990 baseline, the EU has set up three key targets to be met by 2020, viz. cutting its greenhouse gas emissions by 20%, improving energy efficiency by 20%, and an increased use of renewable energies to 20%. The Chinese government has also attached great importance to climate change. In 2007, the Chinese government released "China's National Climate Change Program" which clarified the objectives, principles, key areas, policies and measures for addressing climate change for the period up to 2010. It is also a

guideline for the provincial governments to take action against climate change, and a priority for implementation.
3) The strategies implemented to cope with climate change may influence local energy development. In Italy, the main energy supply is from natural gas (36%) and petroleum (43%). Renewable energy sources such as small-scale hydropower only make up 7%. Nuclear power plants have been shut down since the 1980s due to public opposition, and the energy-strapped country has been depending heavily on energy imports, including nuclear electricity generated by nuclear power plants in neighboring countries. In the light of the current climate change initiatives to reduce greenhouse gas emissions however, Italy is now reviewing its nuclear power policy and considering the possibility of reconstructing nuclear power units. Nuclear energy is a clean energy source and China should also follow this direction.
4) Reducing greenhouse emissions can also be achieved efficiently via traditional measures. In Europe, energy consumption has been drastically reduced or, in other words, greenhouse emissions (mainly carbon dioxide) have decreased, by improving the thermal insulation of building blocks and using high-quality double-glazed windows. From this perspective, emission reduction measures to counter climate change do not have to involve huge investments and the development of new technologies. It can be achieved using current technology through energy-efficient renovations of both existing and new residential compounds.
5) Some unique approaches adopted by many European countries to deal with climate change - their successes and lessons - are worthy of consideration. In The Netherlands, where large areas of land are below sea level, the country has worked out the bold but creative idea of floating offices and residential blocks by combining spatial planning with climate change. Way back in 1992, the German city of Hanover set a goal to cut greenhouse gas emissions by 25% by 2005 and subsequently put in a great deal of effort towards encouraging public participation, improving the energy efficiency of residential blocks, cogeneration (CHP), and promoting the development of renewable energy. Although the emission levels of the city in 2005 were 7.5% lower than the levels in 1992 and they were already in the top league among all European cities, they were still miles behind their original goal of 25%. Clearly, some climate change strategies in Europe were successful, but others were not.

3 What needs to be continued after this training?

Feedback:
1) More research and application needs to be done to improve energy efficiency in residential houses in the future.
2) We need to speed up institutional arrangements for climate change.
3) We need to gain an in-depth understanding of the trends in dealing with climate change. Coping with climate change has been a new function of the National Development and Reform Commission (NDRC) in recent years, and it is certainly a challenge, but it is also an opportunity at a provincial (city and district) level. On the one hand, climate change is a brand-new field and many concepts and activities are unprecedented, so we need to learn continuously and review constantly. On the other hand, many projects involved in combating climate change can be developed further and opportunities are emerging all the time with regard to climate division and international organizations. A good project can help to achieve a breakthrough in the work of the provincial branches of the NDRC.
4) We need to further strengthen our comprehensive capabilities in the workplace, improve our English skills, build a smooth communication platform and develop a transparent management system.

4 Suggestions for the next training program.

Feedback:

1) Extend the training to one month if possible.
2) Spend more time in other cities. Our stay in Milan was too short.
3) We need translators who can speak better Chinese so we can understand and learn more.
4) We hope that buyers, middlemen, DOEs, and consulting firms can also engage in the training.
5) The levels of the Chinese trainees varied. The organizers should find out the demands and expectations of the trainees in advance, and the level of the training itself should also be higher.

5 Other interesting findings during the training.

Feedback:

Although Italy has a developed economy, ordinary citizens lead rather frugal lives. They prefer practical commodities. For example, the cars we saw in Italy were mostly small for the sake of energy efficiency. In China, however, people prefer large vehicles. Italy's attitude is more pragmatic and environmentally friendly, and we should learn from them.

Chinese Academy of Social Sciences
E-learning Study Tour

Italy, June 4-13, 2009

The 14 trainees from Qinghai, Shanxi, Xinjiang, Hunan and Beijing took part in the Italian study tour of e-learning training for the Sino-Italian Cooperation Program on Sustainable Development and Environmental Management from June 4 to 13. The trainees benefited a lot from the study tour, not only in the theory of environmental protection and sustainable development, but they also deepened their understanding of serious environmental problems confronted by Italy and China and the feasible solutions, their implementation, and technology issues. Therefore, it raised the environmental protection awareness of the trainees and strengthened their confidence in solving the urgent environmental problems in China.

The trainees concluded that there were three major aspects regarding the training: firstly, it was mainly on environmental protection and sustainable development issues. The course was closely related to the actual environmental status, covering sustainable mobility, new industrial and technological development, urban waste management, resource recycling and reuse, sustainable agricultural development, etc.; secondly, it adopted a scientific approach to reinforce the training, such as carrying out the tour step by step, introducing the general situation and then going into specifics, delivering the lecture first followed by the discussion session, and the theory learning before the site visits. These approaches not only enhanced the trainees' interest in learning but were also useful for them to digest and absorb the knowledge; lastly, the schedule was neatly organized. From the staff at the training institute, to the lecturers and the receptionists at the site visits, all were very enthusiastic and sincere to every trainee, which made everyone enjoy the training.

During the whole journey, the trainees found that the concept of environmental management and sustainable development had penetrated into the Italian people's daily life and various aspects of their social and economic operation. It is worthy for China's reference to note that in the process of Italian environmental protection they are not only restricted by legal systems and laws, but also by ethics; specifically, China can take reference from Italian experiences in the aspects of waste management, car sharing and pooling systems, environmental protection investment and financing models and interest allocation procedures, amongst others.

Although the training organization has improved continuously with more substantial courses, there are still some suggestions from the trainees. Firstly, they hope that the Italian lecturers can visit China more in order to know China's actual conditions and its environmental problems. Therefore, some contents in the lectures was not suitable for China and could be adjusted. The lecturers could then put forward more specific, reasonable and practical suggestions or solutions for China's environmental protection problems. Lastly, some data in the lecture was relatively out of date, so they hope that updated data and cases will be introduced.

Ministry for Environmental Protection
Environmental Monitoring Management
Italy, April 18 – May 2, 2009

From April 18th to May 2nd, we (being 24 administrators and technicians from the environmental monitoring departments of 17 provinces around China) attended the training on environmental monitoring management and techniques in Italy, which was co-organized by the Italian Ministry for the Environment, Land and Sea and the Ministry of Environmental Protection of China.

During this period, we became acquainted with the structure and operating mechanism of the Italian metereological system and laboratory quality control system, the directives and techniques of air quality monitoring and water quality monitoring, and the concept and preliminary results of an integrated management system of environmental data etc.

Unlike us, the EU and Italy rank air pollution into four levels. The higher the level is, the more methods should be taken to lower it. The money-saving advantage of this method makes us think it is feasible in China. Besides, the Italian Environmental Protection Agency imposes some conditions on the position and the amount of air quality monitoring stations, likewise the amount of inhabitants in monitoring areas, and the function of monitoring areas etc. By doing so, the monitoring results are more accurate and reliable. In China, the need for more accurate air quality monitoring data is growing. Through the training we may find one kind of solution.

For water monitoring, we learnt that the EU and Italy are using biological methods as another important way to evaluate water quality, combined with traditional chemical methods. Biological methods directly estimate the effects of chemicals on living organisms, whilst chemical methods can analyze the chemicals in polluted water precisely. The combination of the two methods comprehensively reflects the situation of water quality. Ecological monitoring methods have already been used in a few of China's big cities. After learning of the advantages, we think we should promote it more widely.

We also learnt that the National Research Council of Italy is trying to integrate all environment-related information systems into a bigger system which they call "the system of systems". In this system, the environmental data from different collecting departments could be freely shared and could greatly improve the efficiency and utilization of this information, accelerating the process of decision making. This project sets a good example for China on how to share environmental data from various departments and places, as this is a long-term problem in China.

After the training, further connection between Italian environmental monitoring administrative organizations, research institutes and those of China should be established, which can create for us more opportunities to directly exchange our experiences, information and knowledge. We also expect that VIU will continue to upload new material related to the training on the website.

For the next training program, we suggest that the length of training should be cut and we would appreciate it if the content of the classes could combine more working field visits with more instructions regarding their daily work.

Lastly, we must express our sincere appreciation to the Italian Ministry for the Environment, Land and Sea, training teachers and staff from VIU. By undertaking this training, we got a full picture of the policies, techniques and methods of environmental monitoring in Italy and the European Union. We also found that Italy is a beautiful country with nice people and hope the friendship between our two countries could last forever.

Multilateral Environment Agreements (MEAs), MEP
Italy, May 16-30, 2009
23 participants

During the collaboration between Venice International University (VIU) and the Ministry of Environmental Protection (MEP), several crucial environmental issues were discussed. The advanced training programs are organized for a selected delegation by the Ministry of Environmental Protection. In particular, from May 16-30, the 2009 Multilateral Environment Agreements (MEAs) advanced training course took place thanks to the collaboration between VIU and Agroinnova, with the support of IMELS.
The 23 participants were taken through the different aspects of MEAs, including policies, industry, voluntary agreements, biodiversity conservation and agriculture. The MEAs are the subject of great interest, applicable in many fields. During the course their possible application and replication were discussed, drawing special attention to fruitful and successful case studies, but also the main problematic aspects of their application. This discussion always followed an overview on the history of MEAs and their structure. In order to involve the participants in an ongoing network and to make the course more practical, the experts delivered both workshops and lectures and also guided the delegation through site visits.
The delegation was very active and with a positive approach contributed to the lectures and site visits with questions and discussions and also showed interest in possible future cooperation. The training course combined this interesting path of knowledge on MEAs with several leisure activities in Rome, Turin and Venice.

Environmentally Friendly Cities, SEPB
Italy, May 23-June 6, 2009
20 participants

In 2009, VIU and the Municipality of Shanghai decided to dedicate two training courses to “Environmentally Friendly Cities”, thus demonstrating the willingness of Chinese policy makers to face the serious pollution problems within Shanghai.
Shanghai in fact deals with the same environmental problems as all big cities worldwide, in particular, those coming from traffic congestion and air pollution, and water and waste management.
Chinese cities in particular are growing very fast and buildings are built and dismantled continuously. China is the biggest builder worldwide with 1 billion sqm of construction annually.
For this reason VIU decided to involve an expert from the Polytechnic Institute of Turin (prof. Blengini) on “demolition waste and recycling potential” in order to present Italian solutions for dealing with this issue.
Moreover, the delegation asked to devote some lectures to the “emergency response to pollution accidents” issue. To satisfy this request, VIU decided to organize a lecture and a site visit to present the Industrial Monitoring and Alarm System (SIMAGE) in Venice. An expert from ARPAV (the Regional Agency for Environmental Protection and Prevention of the Veneto Region) presented the design, establishment and management of this system and took the delegation to the control room and the monitoring stations to let participants experience the system in practice.

Green Cities, BMEPB
Italy, July 11-25, 2009
15 participants

The second training course of 2009, jointly organized by VIU and BMEPB, was devoted to the “Green Cities” issue.
The BMEPB delegation expressly asked to cover this topic, demonstrating the willingness of the Beijing Municipality to improve the quality of life in the city.
Considering the major environmental difficulties in Beijing, the municipality wanted to explore in depth the kind of solutions Italy pursues to manage air quality and prevent air pollution.
VIU decided to devote several days to this topic involving experts from ARPAV (The Agency for Environmental Protection and Prevention in the Veneto Region) and IIA-CNR (Institute for Atmospheric Pollution).
Since one of the major sources of air pollution in China and also in Italy is traffic emissions, VIU decided to involve experts on sustainable mobility to cover the topic of air quality not only from a theoretical point of view but also by presenting practical case studies from Milan and Rome.
To present a successful Italian case study of urban sustainability, VIU involved an expert (Dr. Abbati) from the Municipality of Ferrara.
In fact, Ferrara won the “European Sustainable Cities Award” in 2003, demonstrating the progress made by local authorities in sustainable development activities.
Dr. Abbati presented the role of some of the tools of sustainability such as environmental management systems, communication, information and best practices for reaching the goal of urban sustainability.

Eco-Management: Strategies and Policies, E-learning Study Tour, CASS
Italy, September 10-19, 2009
15 participants

After the first study tour held in June, another delegation of 15 participants selected by CASS arrived in Italy to close the third year of the E-learning program.

Starting with three cities and only 60 participants in the pilot project in 2006-2007, the program widened its range of action to include another five cities, thus covering more remote areas of such a vast country. Following the increase in the number of cities covered by the program, the number of participants increased to nearly 380.

This is an excellent result as it means more and more Chinese civil servants, professors, engineers and managers have the chance to learn about and discuss different topics concerning sustainable development and environmental protection.

The aim of the study tour is to further analyze the topics discussed during the introductory session broadcast held in Beijing in March. From this perspective, the agenda was organized as a series of meetings and site visits with institutions working in such fields as sustainable mobility, urban and industrial sustainable development, green production, waste water treatment, waste management and sustainable agriculture.

The agenda included a visit to ATAC S.p.A., the Mobility Agency of the City of Rome, where the delegates had the chance to understand how the city is trying to deal with the problem of emission reduction through the promotion of car sharing and a review of the public transport system.

While in Venice, COSES and Ente Zona Industriale, a research center and an association of industries respectively, were involved in a meeting to explain the Venice Province Plan and the role of Porto Marghera's industrial zone. The latter was also analyzed during the visit to VEGA, Venice Science and Technology Park, built on reclaimed land which has become a real point of reference for advanced research and technological innovation.

The participants were also able to visit one of the most important Italian companies producing bottled water, San Benedetto S.p.A., as an example of how to reconcile the production process with the protection of the environment. San Benedetto recently signed a project with the Italian Ministry of the Environment to further reduce CO_2 emissions under the provisions of the Kyoto Protocol, and has started using bottles with a reduced amount of plastic.

The last day in Venice was devoted to a visit to two innovative plants for the treatment of waste and waste water.

Finally, in Turin the delegation visited Agroinnova, where studies and projects on sustainable agriculture are carried out and the Dongtan Chongming Island project in particular was explained.

The delegates showed great interest throughout the entire study tour. They took full advantage of this opportunity by discussing and interacting with the lecturers, and they hope to be able to apply the knowledge acquired to their everyday work.

Eco-management: Strategies and Policies, CASS
Beijing, 160 participants
and
Capacity Building on Sustainable Development, MOST
Beijing, 31 participants
The two courses held in Beijing from October 12-16 were organized in cooperation with the first two partners of the Advanced Training Program: the Chinese Academy of Social Sciences and the Ministry of Science and Technology. Though both of them were focusing on sustainable development, the agendas were designed to accommodate the different backgrounds of the selected participants.
The Beijing session of the CASS Training marked the opening of the 7th year of cooperation with the Chinese Academy of Social Sciences and it was addressed to 160 participants, mainly selected from local administrations from all over China. The agenda was therefore targeted to give a broad overview of the different aspects of sustainable development and environmental management. For this purpose, lectures consisted of a general introduction to central topics such as sustainable agriculture, green industry and economic development, sustainable land use and remediation linked to sustainable urban development, international environmental law, eco-building, energy efficiency, the economic and environmental protection situation in China, with special attention to the financial crisis, sustainable water consumption management and climate change. According to the participants' backgrounds and interests, they will go on to do one of the four courses organized in Italy between November 2009 and March 2010. Each course section will focus on more specific issues linked to energy efficiency, sustainable urban development and eco-building, waste management and water management.
For the Ministry of Science and Technology, on the other hand, VIU set up an agenda with a greater focus on energy and related matters, in order to better target the technical and technological background of this Chinese institution. For this reason, many lectures on energy efficiency policies, energy saving buildings, China's policies on energy saving and emission reduction, use of new and renewable energy, sustainable energy use, as well as climate change and CDM were presented. As MOST is one of the Chinese institutions most actively involved in the country's climate change debate, the decision to stress the importance of China's need to find new technologies, sources and policies to improve energy efficiency and the use of clean energy is strongly justified.

Energy Conservation and Efficiency, MOST
Italy, November 12-21, 2009
24 participants
In the run towards the exploitation of renewable energy sources, it is sometimes forgotten that the best way of increasing energy availability is not to waste energy.
Energy efficiency could in fact be applied to every possible aspect of everyday life, and this is especially true for China, which is constantly increasing its energy consumption due to urban and industrial growth.
With this in mind, VIU organized a course for MOST participants dealing with this important issue and addressing a wide range of possible case studies in which energy conservation is not only recommended but also required by law. In addition, new possibilities for obtaining more energy from conventional and renewable sources were explored.
The residential sector, known to require up to 40% of the total energy consumption of a

country, is a strategic field in which energy efficiency can be effectively applied.
Eco-building is of great importance and its technologies are applied increasingly, not only for privately built houses but also for social housing projects carried out by municipal governments. These houses do not cost more than conventional buildings, but the savings for residents are considerably higher.
During the course, specific focus was given to the certification of energy efficiency in buildings, now required by European law. Currently this tool is compulsory only at local level in some municipalities but it is expected to be applied to all new buildings in the near future when only buildings consuming the least energy will be permitted to be constructed. A similar certification is also expected for existing buildings that consume less energy in order to increase their market value.
Energy recovery from waste incineration is another way of producing energy, exploiting as fuel a material that would otherwise be discarded. This method is, however, promoted by European law only for the fraction of waste that remains after the separation of recyclable material. In Venice, an advanced RDF plant produces high quality fuel from the non-recyclable fraction of urban waste. This fuel is utilized in a thermal power plant nearby as a substitute for the equivalent amount of coal. This allows the municipality of Venice to dispose of waste in a safe way and simultaneously, it allows the power plant to save on coal while producing the same amount of electrical energy.

GEF China PCB Management and Disposal Demonstration Project – Mid-term Review

The GEF China PCB Management and Disposal Demonstration Project is presently undergoing its mid-term review. The positive results reached up until now will mean that by the beginning of 2010 all the project facilities will be ready. The project will then be fully operational.
The main objective of the GEF China PCB Management and Disposal Demonstration Project is to “identify and demonstrate environmentally-sound and cost-effective policies, procedures and techniques for safely managing China’s PCB contaminated sites and disposing of associated PCB-contaminated wastes”. The project (overall budget of 33 million USD) is funded by GEF, China’s central and provincial governments, and is bilaterally supported by Italy (1.25 million euro), the USA (70,000 USD) and Japan (0.4 million USD).
The implementing institutions are the World Bank and the Convention Implementation Office of China’s Ministry for Environmental Protection.
After two years of implementation, the project has successfully achieved the following results:
1) definition of a complete set of technical guidelines for PCB inventory, disposal, contaminated site clean-up and characterization, and contaminated waste transportation;
2) proposal of new legislation at a national and provincial level concerning PCB pollution control standards and management of PCB wastes;
3) training in Beijing, Shenyang, Hangzhou on all the technical and management issues related to the disposal of PCB contaminated wastes;
4) ground penetrating radar and environmental characterization of PCB contaminated sites in the Zhejiang province;
5) feasibility analysis, impact assessment and procurement of a Thermal Desorption Unit and a PCB storage facility in Zhejiang. By the beginning of 2010 the Thermal Desorption Unit for the decontamination of PCB soil removed from the contaminated sites will be operational;
6) feasibility analysis, impact assessment and procurement of an upgraded hazardous waste incinerator and related waste pre-treatment facilities in Xinmin and Shenyang. The incinerator was upgraded and the trial burn test was successfully completed in September 2009.

International Conference on the Appraisal Mechanism of Environmental Damage

In November 2009 an international conference on the regulation and evaluation of environmental damage from pollution accidents was held in Beijing.
The event, organized by MEP and IMELS, summarized the results of the project developed within the framework of the Sino-Italian Cooperation Program.
It aimed to support the Chinese authorities to properly address the environmental damage and estimate the related economic losses, thus promoting the prevention of environmental pollution accidents.
Under the supervision of the MEP’s Department of Policy, Laws and Regulations, and managed by PMO, the project was implemented by CAEP (Chinese Academy for Environmental Planning) in collaboration with the Institute of Applied Law of China’s Supreme Court, along with a team of Italian experts.
The main project outcomes were:
i) a comparative analysis of international experiences in the regulation and evaluation of environmental damage;
ii) an overview of typical pollution accidents and related damage evaluation in China; and iii) a set of recommendations to establish an adequate system in China.

Contaminated Site and Soil Remediation Management: New Action Launched

On November 13, 2009, a kick-off meeting launched the "Technical Support for Contaminated Site and Soil Remediation Management" project within the framework of the Sino-Italian Cooperation Program for Environmental Protection (SICP).
The scope of this new activity was to support the brownfield sites remediation, thanks to the large experience gathered by the group of Italian experts and the Chinese Authorities (MEP, the Chinese Research Academy of Environmental Sciences and the Jin Lin Environmental Protection Bureau) in the prevention of soil and groundwater contamination and in the management of contaminated sites.
Within the project development, a specific focus will be devoted to: a) an applicable system of standards and guidelines for the cleanup of contaminated soils appropriate to the protection of human health and ecosystems, and to allow the economic recovery of contaminated sites; b) the development of a national inventory of contaminated sites; c) the application of testing and calibrating standards and guidelines for practical cases, and d) strengthening technical and administrative capabilities through international study visits and a dedicated workshop.

Sino-Italian Pavilions Stand Out in the Shanghai World Expo "Urban Best Practices Area"

The construction of the pavilions in the Urban Best Practice Area of the 2010 World Exposition in Shanghai was completed at the end of November with a celebration attended by the highest profiles from the Bureau of the World EXPO Coordination.
The "Urban Best Practice" (UBP) is a new concept where, for the first time in the world exposition's history, cities - not just countries - will be able to showcase their unique features and practices for sustainable urbanization. Here, 40 or more international cities (among them, Bologna and Venice) selected by an International Selection Committee, will showcase their experiences.
The Italian Ministry for the Environment, Land and Sea (IMELS) is the first international body to support this valuable initiative, contributing, through the Sino-Italian Cooperation Program for Environmental Protection, to the design and construction of two pavilions, namely C1 and B3.2, and the restoration of a third one, B2, in the UBP Area.
In cooperation with the Bureau of Shanghai World Expo Coordination, IMELS has contributed to the diffusion in China of eco-efficient architectural design and Italian building materials and technologies, with the flagship eco-building projects in Beijing, such as the recently inaugurated Environmental Conventions Building (4C Building).

Chaohu Lake Management Priority Interventions Officially Presented

The workshop, which concluded phase 1 of the MITIC project (Monitoring Improvement and Treatment Improvement of Chaohu Lake), took place on November 19th in Chaohu City. The project began in January 2009 and was implemented by Italian engineers, together with the Chinese partners, Anhui and Chaohu Environmental Protection Bureaus, within the framework of the joint initiatives of the Sino-Italian Cooperation Program for Environmental Protection. MITIC is a multi-tasking feasibility study aimed at finding viable solutions for safe and sustainable lake water exploitation for Chaohu City (160,000 people in the central urban area, but with a rapidly increasing population).
The study focused on: a) upgrading the monitoring systems for the lake and water treatment plant and applying remote sensing to develop a SCADA (Supervisory Control And Data Acquisition) system using neural networks to support, prompt and effectively manage emergency situations; b) upgrading water collection and treatment technologies; c) controlling trophic levels by pinpointing critical loads and striving to improve lake health in an integrated watershed view. The project methodology strongly relied on the valuable efforts of the Chaohu municipality and the Environmental Protection Bureau in enhancing the quality and frequency of the monitoring process at the lake, intakes and treatment plants, and coordination among the different stakeholders.

what's next

The 2010 Advanced Training Program confirms that the topics of environmental monitoring, energy and climate change are central to the interests of the seven Chinese institutions participating in the program.
The Italian Ministry for the Environment, Land and Sea fully recognizes the importance and impact of the training program, confirming its continuing support of the 27 training courses, of which five will be arranged in China (including the distance-learning program) and the rest in Italy.
A total of 512 Chinese civil servants, policy-makers and entrepreneurs are expected to visit Italy in 2010, whilst the beneficiaries of all capacity-building activities (including distance learning) are expected to be around 1,050.
The courses on environmental monitoring will address policies and mechanisms for pollution control and the management of pollution sources. They will refer widely to the monitoring of soil, water and air (in the case of the Chinese Ministry of Environmental Protection) and air quality (in the case of the Municipality of Beijing).
The courses on energy and climate change will vary from specific sessions on climate change management and its implications in terms of policies and mitigation /adaptation strategies (as in the case of the National Development and Reform Commission of China) to broader sessions on low carbon economy, renewables, and energy efficiency (as in the case of the Chinese Ministry of Science and Technology and the Municipality of Shanghai).
The courses on Multilateral Environmental Agreements and on sustainable development, with particular emphasis on technological innovation, will be arranged with the Tianjin Science and Technology Committee and the Chinese Ministry of Environmental Protection as international policies will be covered.

The cooperation between VIU, Tsinghua and Tongji Universities will continue through the exchange of students and scholars and through the organization of joint workshops. VIU students attending the globalization program, selected from the Chinese and Economics departments of Venice's Ca' Foscari University, will attend the Chinese universities to carry out research for their theses in the fields of globalization, economics and the environment.
VIU will use the 2010 Expo in Shanghai as a good chance to celebrate the cooperation with its Chinese partners.
An alumni event, jointly designed by VIU, IMELS and the Chinese Academy of Social Sciences, will celebrate the 7th year of the Advanced Training Program with the program's best students gathering at the Shanghai Expo's Italian Pavilion. This pavilion will also host the opening of the training with the Municipality of Shanghai which, like last year, will focus on SEA - Strategic Environmental Assessment.
VIU will also be part of the expo's Urban Best Practice session, as Venice International University and the the island of San Servolo (on which it is situated) have been selected as a successful case study in the redevelopment of urban areas.