CIGB ICOLD

The Dams Newsletter

http://www.icold-cigb.org http://icold-cigb.net No. 5 - May 2006

ICOLD KNOWLEDGE FOR THE BENEFIT OF SOCIETY

President
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ICOLD has already played a significant role in spreading dam technology and helping the development of hydro resources of many countries. But there are still numerous countries with indexes of development that pose a challenge to the world. They lack food security and have very limited access to clean water and to electricity.

We believe that dams have an indispensable role in improving the development of the poor countries, through irrigation, sanitation and hydroelectricity. In many circumstances, these cannot be achieved without the dams. Taking into account those considerations we are fostering several important actions in the management of ICOLD. One of them is the attraction of new member countries; so far Vietnam and Latvia have joined ICOLD community; it is a modest start, but we are hopeful that several other countries will apply for membership at the Barcelona Executive Meeting.

Another action is related to provision of easy and cheap access to the technical bulletins, either through CD-ROM's or internet.

Moreover the translation of the technical bulletins into other languages besides the official English and French is being increased. Many bulletins have been translated into Spanish, Portuguese and Chinese. We are dealing to have translations into Russian and Arabic. Whenever we have the bulletins translated into those languages, we will be covering a very large proportion of the population of the world. In a meeting with representatives of African member countries, an interesting idea arouse, that is to get the voluntary contribution of retired experienced engineers. ICOLD could help the organization of "Dam Engineers without Borders" that would provide work for situations of high need, as for instance, related to the safety of dams.

Last but not least, it is important to contribute to capacity building in the developing countries.

I have talked to several people and entities about creating a school in Brazil to train overseas dam engineers. Brazil could be an ideal location because there is ample knowledge to be transferred and the cost of living is cheap. Many National Committees of ICOLD have been approached to provide training to engineers from abroad. Negotiations have already resulted in agreements of ICOLD with the Turkish Committee (DSI) and the Moroccan Committee (Secretariat of State in Charge of Water). Implementing all those actions will certainly make ICOLD render a significant contribution to the well being of the world and become an association even more useful than it is nowadays.

CBViotti

IN THIS ISSUE

Role of Dams in the 21th Century

The ICOLD Committee on Governance of Dam Projects is currently working on a document titled "Role of dams in the 21th Century to achieve a sustainable development target"

With the kind permission of the Committee Chairman Raymond Laffitte and of the document's author, François Lempérière, we will publish here some excerpts of the draft document as "food for thought". In this issue, we publish the interesting observations made on the data about existing dams and the conclusions about the likely development of dams, motivated by the necessity of satisfying the future needs of humanity in a sustainable way.

1. Existing dams and construction trends

Data below are mainly based upon the analysis and comparison of various ICOLD Dam registers (1982 to 2003) and of the World Atlas of "Hydropower and Dams". Some other data are specific from China and India.

There are about 50 000 dams higher than 15 m and / or storing over 3 million m^3 of water called "large dams". There are over 100 000 smaller dams with storage over 100 000 m^3 and millions under 100 000 m^3. The overall storage capacity is close to 7000 km^3 of which 98 % for the "large dams". The live storage is in the range of 4000 km^3 i.e. 10 % of the worldwide yearly rivers flow. The overall area of reservoirs is 500 000 km^2, one third of the area of Earth's natural lakes. 95 % of the investments in dams and reservoirs were made after 1950.

The figures below refer to the large dams and underline their great differences: there is as much difference between a "very large dam" and a "small large dam" as between a nuclear plant and a truck engine.

- 50 % of the world's overall storage capacity is achieved by only 100 huge reservoirs storing over 10 billion m^3 each, and 40 % more of the world's storage is within 2500 reservoirs ; lastly, about 40 000 "large dams" store, as an average, 5 million m^3.
- 600 dams are higher than 100 m; 2000 between 60 and 100 m high; and 10 000 between 30 and 60 high. Half of "large dams" are lower than 20 m.
- Thousands of large dams are built on very large rivers with spillways capacities of between 1000 and 100 000 m^3/s. But over 80 % of "large dams" are on rivers of average yearly flow close to or under 1 m^3/s with spillways capacities between 50 and 500 m^3/s.

Thus the analysis of dams should be clearer if the "large dams" are classified into 2 categories:

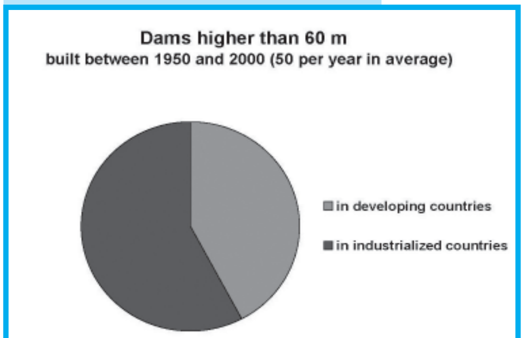
1.1. Very Large dams

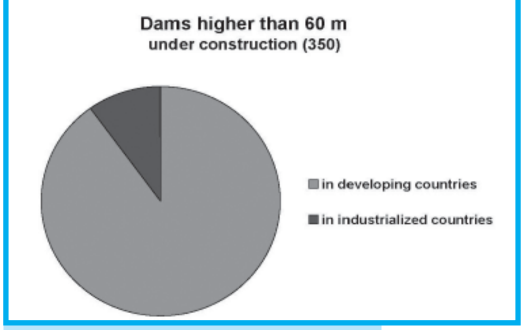
5000 "very large dams" higher than 60 m and / or with storage over 100 million m^3 and / or with spillway capacity over 5000 m^3/s. This category provides over 90 % of the worldwide storage and their benefits are over 80 % of the dams benefits. Most dams in this category may be represented by a dam 100 m high constructed of rockfill or concrete mainly devoted to hydropower. Its reservoir impounds a few billion m^3 on a 100 km^2 area. Its investment cost is U.S. $ 500 millions. It is gated. But the "very large dams" include also dams lower than 60 m with huge storages and / or very important spillways. As average such very large dams are about 30 years old and their anticipated life is well beyond one century more. Very few have been decommissioned.

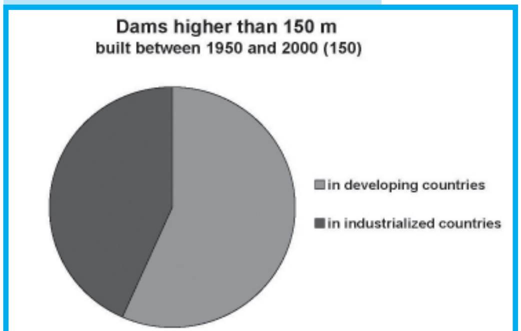
1.2. Other large dams

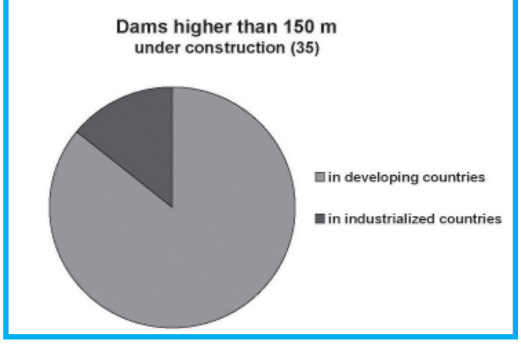
45 000 other "large dams" with reservoirs area under 10 km² (most under 1), an average height under 25 m and an average in flow of 1 m^3/s. Such dams are most often earthfill dams mainly devoted to irrigation. Although some thousands of these dams required an investment between 10 and 100 million U.S. $, the average cost was much lower, often close to 1 million $ and even less for over 20,000 dams built by hand in Asia before 1980. However these rather small dams were a key asset for food and water of hundreds of million people.

As average these dams are about 40 years old. The total span life may be less than one century for many rather small reservoirs but will be over one century for most of them.









Various criteria may be used for evaluating the present global trend in dams' construction:

- The yearly number of large dams completed was in the sixties or seventies five or ten times the present number and this presentation is often used to demonstrate "the dramatic decline in the path of dam building over the past two decades". As the unit value varies from 1 to 1000 and the reduction in number applies to the smaller "large dams" this reference has no serious meaning.
- The storage: Over 80 % of the world dams storage is for hydropower: the water storage per yearly kWh has varied considerably according to the country (0.5 m^3 per kWh in Europe, 5 in Russia or Africa) and to the construction period (over 3 before 1980 and about 1 now). The slower storage increase since 10 or 20 years is essentially due to this change in ratio m^3/kWh. Moreover the cost per m^3 of storage may vary from under 1 cent of $ up to over 10 $. The overall storage volume is thus a poor representation of the cost and benefit of dams.

Better references are benefits and costs: the dams under construction will supply 15 % of the present hydropower, i.e. an increase by about 2 % per year. The number of rather small irrigation dams under construction has dramatically reduced but half of the largest dam irrigated areas have been implemented since 25 years and a large part of the dams higher than 60 m under construction are devoted to irrigation.

The overall investment is a better indication of dams building activity. The actualized value of all dams built since 1950 is roughly estimated to 1500-2000 billions U.S. $ and the yearly rate in the 90s at 30-40 billions i.e. 2 % of what was achieved in 50 years.

The cost varies more with the height and spillage capacity than with the storage. Most of the investment has been and is in dams higher than 60 m: 2600 were built between 1950 and 2002 (50 per year) and 350 are under construction. 150 dams higher than 150 m were built before 2000 (3 per year), and 35 are under construction. And half of the 30 world spillways over 50 000 m^3/s have been built since 20 years.

There is thus, since 20 years, a dramatic decline in the yearly number of "large dams" completed but no such decline for the "very large dams".

There is since 20 years a decline in the yearly rate of extra storage which does not mean a reduction in the yearly increase of the role of dams.

There is since 20 years a dramatic decline in the dam investment in industrialized countries. But large industrializing countries which did focus 30 years ago on many rather small dams built by low cost labour are now spending huge amounts on very large schemes.

2. Future needs and economically feasible potential

For purpose of this analysis we have used a planning horizon of the mid century. The relevant hypotheses for 2050 are:

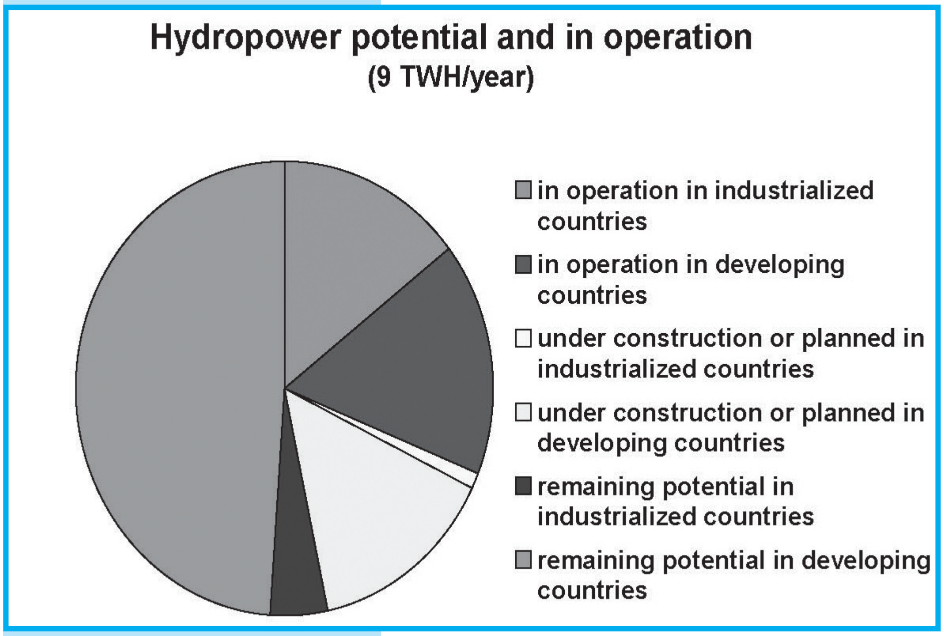
- A world population of 9 billion
- A need of food and water doubled
- A moderate green house effect such as a 2° temperature increase with relevant impacts on droughts and floods.

We will now examine the potential and likely future dams for various needs: hydropower, irrigation, water supply, drought and floods mitigation, navigation …

The study of relevant dams and water storage should take in account the fact that most of very large dams are and will be multipurpose; furthermore, the reservoirs utilization may be optimized during their long life according to the changes in needs. It has been already observed for existing dams.

2.1. Hydropower

In the first years of the 21th century, hydropower, with a capacity of 730 GW (plus 100 GW pumping plants), supplies yearly 2800 TWh, about 20 % of the world electric energy and a high percentage of the grid peaks. About half of existing production is in the most industrialized countries: They have implemented 70% of a cost effective potential of 1800 Gwh/year; Other countries have implemented 20 % of a cost effective potential over 7000 GWh/year.



Over 80 % of present hydroenergy is produced by 2000 large schemes of 1 TWh in average and it is likely that most of the future will be based also on huge schemes. But over 50 000 small hydroplants presently and many more in the future have and will have a local role on alleviating poverty.

Beyond its direct benefit of providing clean renewable power, hydropower has several other advantages and should be viewed within the context of total watershed management. The storage may be a yearly storage but will be more often used for daily or weekly peaks in power grids. It may also favour the new clean energies such as wind or solar plants. The stored water may be used alone with the reservoir head or operated conjunctively with downstream dams or through tunnels to hydroplants. The advantage of energy storage for daily peaks justifies many present and future high head pumped storage plants of huge unit power even with a higher cost per kW.

Another advantage is to adjust quickly the hydroplants to changes in supply needs, thus improving the frequency control. Hydropower is thus very attractive within a regional, national or international grid, well beyond its direct supply benefit.

These advantages are favoured by the fact that transmission lines which were along hundreds of km before 1970 are now along thousands km; in the future quite all hydropower will be used within grids and its utilization will thus be optimized. There are also two huge consequences of these easy transmissions: the most remote very large hydropower resources (such as Siberia or Congo) will find consumers and the need of yearly storage for hydropower will be much less important than it was 40 years ago when many hydropower schemes were not combined with other electric sources. The hydropower will be more devoted to daily or weekly peaks which require much smaller storage.

This may explain the dramatic changes in the ratios between the yearly supplied energy and the water storage. Over 80 % of the world reservoirs storage is used for hydropower and the average ratio is a 2 m^3 storage per yearly kWh but it may vary from 100 to 0 and is 0.5 in Europe and 5 in Russia or Africa; it is for new dams much lower than it was 30 years ago. For instance, the 40 largest reservoirs, devoted at 90% to hydropower, store about 40 % of the total storage. They store 2.500 Billion m^3 for 500 Billion kWh (5 m^3 per kWh), but the ratio was 10m^3/kWh before 1980 (2.000 Billion for 200 Billion kWh) and 1.6 m^3/kWh later (500 Billion m^3 for 300 Billion kWh). And the best sites for huge storages have been used first.

There are and there will be along the 21st century some decommissioning of rather small hydropower schemes but upgrading or extraequipment may balance decommissioning or sedimentation impact. Green house effect will probably increase production in the most Northern areas and reduce it in other areas with an overall small reduction. It is also possible that a larger part of the existing huge storage of hydroschemes will be more devoted to drought and flood mitigation with a relevant small reduction of the power production. It is however likely that in 2050 the yearly production of the presently existing schemes will be in the range of 90% of what it is now.

The world technically feasible potential is evaluated as close to 15.000 GWh/year, of which 8.500 (about 60%) were considered as economically feasible 5 years ago: the probable huge increase of oil cost, the likely premiums to clean energy, the high costs presently accepted for other clean sources of energy may increase this figure, possibly by 10%.

An implementation up to 75% along the century would mean 8.500 1.1 0.75 # 7.000 GWh/year, i.e 2.5 times the present production.

The installed power, presently 730 GW (+100 for pumping plants) may increase even more for meeting peak power requirements and be multiplied by 3 up to 2500 GW. An increase of over 2% per year of the present capacities up to 2050, and 1% later appears realistic. There are presently under construction 120 MW, i.e 15% of the present capacity and 300 MW more are planned.

In the 20th century 80.000 TWh of Hydropower have been produced. In the 21th century, the plants completed in 2000 will produce about 250.000 and the new ones about the same, the total (500.000 TWh) being 6 times the production of the past century.

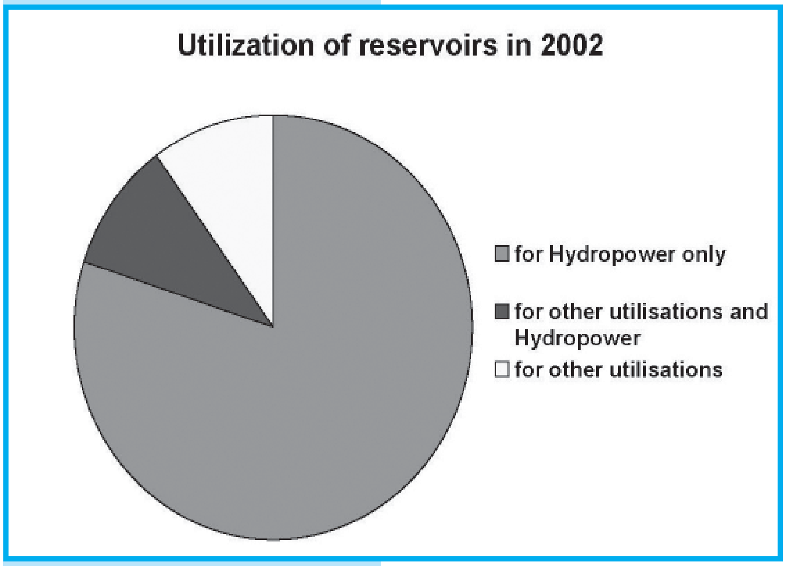
For environmental and resettlement reasons, the water storage per yearly kWh will probably be further reduced for new schemes, particularly in populated areas of Asia and be lower than in the last decade, and thus well under 1m^3/kWh.

An extra storage from 2000 to 2050 of about 2000 Billion m^3 for a production increase of 2800 TWh /year seems a reasonable evaluation. Half of the remaining potential is in five countries (China, India, Brazil, Russia and Congo).

2.2. Irrigation

Dams have been used worldwide for irrigation for many centuries and some are over 500 years old. Few were higher than 20 m before 1950. Over 90 % of the total irrigation storage was created after 1950.

Forty per cent of the world population gets his food from the 250 million irrigated ha of which 30 to 40 % based upon dams storage; 12 to 15 % of the world population, i.e. 7 to 900 million get thus their food thanks to dams. The relevant yearly water volume varies considerably according to the nature of food and the irrigation methods and is globally in the range of 1000 billion m^3 (100 Million ha 10 000 m^3). The storage is not the same because it may be used twice in a year or partly kept over years; and some water in irrigated perimeters is direct rain water.



Most irrigation storage by dams is within few countries: China, India, U.S. and former U.S.S.R. The total relevant dams storage for irrigation is in the range of 500 billion m^3. Ten other countries (Australia, Brazil, Egypt, Iran, Mexico, Morocco, Nigeria, Pakistan, South Africa, Thailand) store altogether for irrigation about 200 billion m^3. The overall irrigation storage of other countries is about 100 billion of which an important part in Southern Europe.

The overall storage for irrigation seems thus under 1000 billion m^3; 80 % is in non industrialized countries.

Irrigated perimeters are in the range of 1 km^2 for the rather small reservoirs and in the range of 1000 km^2 for the very large ones. A part of the storage of huge reservoirs is not used in a close perimeter but through releasing water during dry season for further downstream utilization (for instance for all Aswan Dam irrigation storage). An important part of the irrigation storage volume in used also for flood mitigation.

The evaluation of extra storage for irrigation along the 21th century is difficult:

- The need of food will double within 50 years and the area of available land is limited: the need of irrigated agriculture will more than double.
- Many countries will keep or develop their agriculture for keeping employment and avoiding import of food; the prosperity of many world areas is linked with irrigation.
- The green house effect will probably increase the water needs for agriculture.
- The sedimentation reduces the irrigation dams storage, by a few billion m^3/year.

The need of water storage for irrigation with present methods could thus be multiplied by 3 or 4 in 50 years but there is and should be a continuous progress in irrigation methods which will reduce considerably the water needs. The dam water storage for irrigation may thus be in 2050 between 1.5 and 2.5 times what it is now. A part will be in multipurpose dams. Further increase may be lower.

The present trend varies considerably according to countries; within the 350 dams higher than 60 m under construction, 50 are fully devoted to irrigation and 100 partly. Some countries such as Turkey, Iran and Morocco devote much effort to irrigation dams.

The acceptable cost per m^3 of storage capacity for irrigation dams is limited by the food market. In the range of 1$ per m^3 in industrialized countries, it was much lower

30 years ago in Asia for hand built dams but may there in the future be in the range of 0.5 $ or more.

2.3. Water supply (beyond irrigation)

According to ICOLD data, there are 2500 large dams devoted fully to water supply and as many partly but it is difficult to evaluate the total relevant storage because:
- Most reservoirs devoted only to water supply are rather small.
- Many large reservoirs are combining water supply and irrigation.
- Many reservoirs which were not initially designed for water supply are now used partly for it.

An overall evaluation of the worldwide present yearly withdrawal for domestic use is 9 % x 3800 billion m^3, i.e. 350 billion m^3. Dams storage is used only for a part of the population and along only a part of the year. The relevant storage need is in the range of 50 billion m^3.

The worldwide industrial withdrawal is double that of the domestic one, but a very large part (for instance for cooling thermal plants) is released directly to the river. The utilization of reservoirs storage may thus be in the same range as for domestic use. An overall storage of 100 billion m^3 for water supply seems thus a reasonable evaluation. It is also difficult to evaluate an average cost per m^3; the acceptable investment per m^3 is well over the cost acceptable for irrigation.

Between 2000 and 2050, the world population will probably increase by 50% and the water utilization (beyond irrigation) will increase considerably for most of them. The relevant water needs will probably be multiplied by over 3 when green house effect will reduce the available water during the dry season. There will thus be an extra need of water storage which may hardly be evaluated exactly but will be hundreds Billion. The acceptable cost per m^3 may be much higher than for irrigation, specialy in population with an improved life level. Beyond the construction of new dams, extra storage may be obtained from an increased share of hydroelectric dams storage, or from an even limited heightening of existing dams.

2.4. Dry season releases

A part of the water stored for irrigation and water supply is not used directly but through releases into the river during the dry season and downstream pumping. Such releases may be more important than directly for these utilizations and keeping a minimum flow during the dry season along the full length of rivers will probably be an important target along the 21st century.

Most small rivers and many large rivers (especially in Asia and Africa) are quite fully dry during 3 to 8 months per year. The relevant drawbacks which have huge impacts on poverty are increasing with the withdrawals and the impact of green house effect will probably extend them to many more large rivers along the century. Keeping in the dry season a minimum flow of 10 or 20 % of the average yearly flow may be a reasonable target to be applied for instance to 20 or 30 % of the world large rivers and most small ones.

Increasing along six months the flow of a river by 10 % of the average yearly flow requires the storage of 5 % of the yearly flow. Applying this to 10 000 billion m^3, (i.e to 25% of the world yearly flow) would require an extra storage of 500 billion m^3, partly included in the figures hereabove for additional water supply or irrigation.

Maintaining minimum flows in rivers will also justify huge transfers of water between river basins through canals, tunnels and pumping. This has been widely used in the Western U.S., is under implementation in China, and under study in many countries including India.

2.5. Floods mitigation

Very few dams control completely the floods but many mitigate them; in order to avoid misunderstanding, it is thus better to refer to "floods mitigation" rather than to "floods control".

Many irrigation dams store the yearly flood but few dams store the flood of yearly probability 10-3. As for other structures for floods mitigation (such as levees or detention areas), the main target is actually to mitigate the floods of yearly probability 10-1 to 10-2 through reducing their peak by 30 to 50 %: such reduced peaks are similar to the peak of floods of yearly probability 1/10 which create limited damages. Trying to mitigate much more exceptional floods is usually not cost effective. 2500 large dams are devoted only to flood control, or more exactly to floods mitigation; half are in U.S. Some have a capacity over 100 million m^3 but most have a much lower capacity and their overall storage is under 100 billion m^3.

The impact of multipurpose dams is much more important: for instance, within 350 dams higher than 60 m under construction: only one is totally devoted to flood mitigation but 100 are partly. And many dams which are not designed for floods mitigation have however a serious impact such as some ten thousands free flow reservoirs with reservoir areas over 2 % of the catchment area : the storage within the volume corresponding to the maximum nappe depth over their spillway may reduce by 20 to 50 % the peak of a flood of yearly probability 10-2. This mitigation may often be optimized further.

It is consequently difficult to evaluate the total storage devoted to floods, probably in the range of 500 billion m^3 (including 200 for China); most being used also for other purposes (irrigation or hydropower)

The number of flood fatalities has been reduced since 20 years, thanks to alarm systems and weather forecasting and is few thousands per year but about 10 millions are affected and millions houses damaged or destroyed every year.

The yearly amount of damages by floods (presently about 40 billions U.S. $) may be well over 200 billion $ (at present value) in 2050 for two reasons:

- The value of houses and equipment is increasing, especially in presently developing countries and may be multiplied by over 3 in 50 years in present costs. Many very large cities are at risk and their population is however increasing.
- The impact of green house effect may increase by 20 % as average the floods volume and peak. Such increase means multiplying by 2 or 3 the probability of floods return, i.e. the amount of damages.

It is thus likely that the efficiency of existing flood mitigation dams will be multiplied by over 5 and an extra dam investment of 10 or 20 billions $ per year may be justified in 2050 as compared with few billions presently. It should be also emphasised that centralised floods management, weather forecasting and computerized analyses favour the best utilization of storage for floods. However dams storage will be a part only of flood structural investments including river embankments, low detention areas …

Relevant future dams may be multipurpose but dams devoted only to floods mitigation and fully dry except few weeks per century may be very acceptable environmentally; their design may be quite different from multipurpose dams and their cost much lower for a same storage. The structure and / or operation of many existing dams may also be more adapted to flood mitigation.

The acceptable cost per m^3 of storage for flood mitigation varies considerably and will much increase along the century.

2.6. Other purposes

They have little impact on the overall storage.

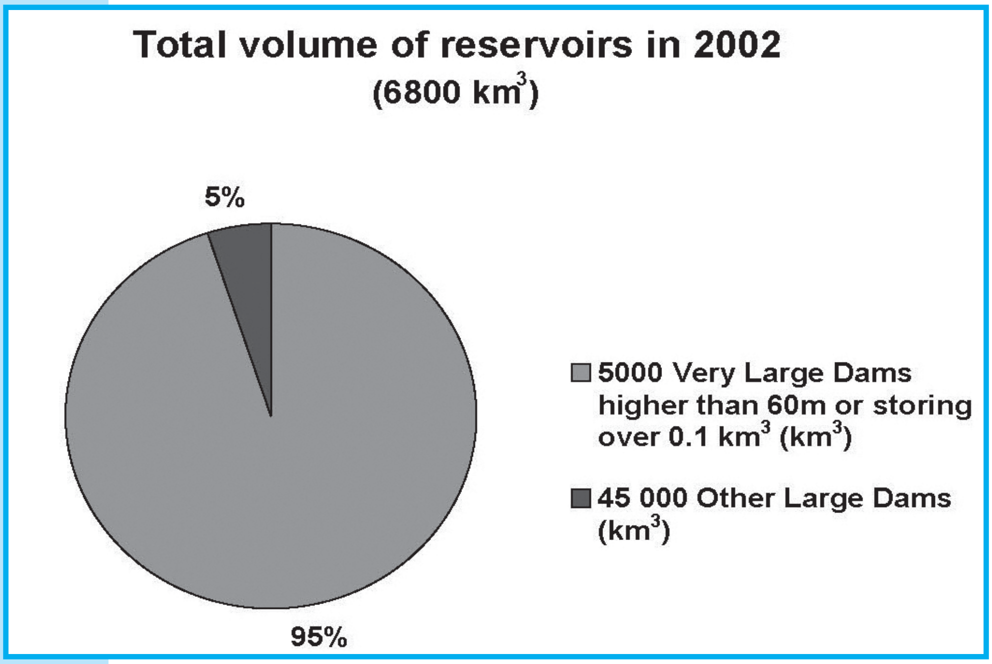
- 100 large dams are devoted only to navigation, several hundred partly. They are usually rather low dams on large rivers of industrialized countries where river navigation is important and environment friend (U.S., Western Europe, …). There may be a serious future in the large rivers of developing countries: one of the main targets of the Three Gorges Dam is navigation.
- There are over 1000 "large dams" fully devoted to recreation (most in the U.S.) but they are usually small reservoirs and their cost and impact are low. The essential utilization of dams for recreation is a partial utilization of over 10 000 large dams and many more small ones for which the recreation was or was not an initial target. Hundreds of thousands of km of riverbanks downstream of dams which were fully dry most of the year may now be used for recreation and many very large reservoirs include huge tourist resorts. This utilization has a great future.
- Aquaculture offers also great possibilities which so far have been used only to a limited extent.

2.7. Global evaluation

Between 2000 and 2050, the role of dams will probably double for hydropower and will much more than double for water supply, dry season releases and flood mitigation. The storage for irrigation may also double with a better utilization i.e for up to two Billion people.

However, the total present water storage, which is presently close to 7000 Billion m^3 will probably increase only by about 3000 Billion. The average cost per m^3 of reservoirs built in the 21st century will be much higher than between 1950 and 2000 because the yearly investment may remain the same for 100 years instead of 50 years and for a storage of 4000 km^3 instead of 7000 km^3.

The overall benefits of dams during the 21st century will be five times what they have been since 1950; Technical, economical and environmental problems, that we will address in the next issue of The Dams Newsletter, should not prevent the implementation of such useful dams. 90% of the relevant potential is in countries which urgently need development and safe water. ●



The Rehabilitation of Hydroelectricity: a pillar for the respect of the Kyoto Protocol

This article is based on a Position paper prepared for the COP 11, The United Nations Climate Change Conference, by Mr. Jean-François Lefebvre, Mrs. Nicole Moreau and Mr. Jean-Yvan Fradet, for the Research Group in Applied MacroEcology (GRAME). It is published in The Dam's Newsletter with the kind permission pf Mr Lefebvre.

The International Youth Summit on Climate Change has declared nuclear power, hydroelectricity and the incineration of waste –unsustainable. This declaration is symptomatic of a serious bias which may significantly hinder greenhouse gas emissions reduction, weaken the chances of reaching a substantial reduction agreement for post-2012, and negate development opportunities to countries where the majority of the population remains without electrical services. Such a bias does not take into consideration the reality of growing energy needs, but is based on a subjective perception of hydropower and other renewable energy sources .

A massive development of renewable energy is necessary

The need for a drastic reduction in greenhouse gas emissions is indisputable. The European Union recommends a 30 % reduction of the emissions of the «developed" countries from the present to 2020. Meanwhile the International Energy Agency predicts that global energy consumption should increase by 60% by the year 2030 and that 85% of this increase will be met by fossil fuels. A significant increase in energy efficiency efforts will only be sufficient to curb energy demand.

In order to reduce GHG emissions and meet Kyoto objectives , not only will a significant increase in energy efficiency efforts be necessary, but also the massive development of renewable energies (see graph to the left).

Hydroelectricity contributes to reducing GHG emissions

The controversy surrounding GHG emissions resulting from hydroelectric reservoirs has been fuelled by ideologically-based biased analyses (such as the "small is beautiful" dogma). Below are two examples that are commonly used by those who oppose hydroelectric projects:

In the first case, opponents frequently refer to what is perhaps one of the worst hydroelectric projects to ever have been implemented in terms of GHG emissions, the Balbina dam on the Utama River, a tributary of the Amazon, in Brazil.(New Scientist magazine, May 4th, 1996).

The second case is exemplified by controversial reports published by the Freshwater Institute in 1993.. The latter multiplied by a factor 10 the actual GHG emissions resulting from the Grand Rapids project in Manitoba. The reports also failed to mention the other hydroelectric power station that also use the Cedar Lake reservoir

(Chamberland *et al.* 1996). The hydroelectric sector certainly has its detractors, including the International Rivers Network. Such bodies tend to extrapolate and draw generalizations with the aim of discrediting hydroelectricity. It seeks to achieve this goal by drawing on impacts that are unrepresentative, that are taken out of context, and by using what are sometimes obvious methodological biases. With approximately 25 to 100 times fewer GHG emissions than coal, hydroelectricity clearly makes their reduction possible. The stake is now to determine whether hydroelectricity is indeed sustainable.

An ecologically sustainable energy sector

A very relevant indicator that may be used to determine the "sustainability" of an energy option, is the energy payback in relation to the energy investment. During its lifespan, a hydropower station will produce between 48 and 260 times the energy required to build it. This ratio ranged between 5 and 39 times for wind turbines, between 1 and 14 times for solar photovoltaic generators and 14 times for natural gas turbines (IEA, 2000). While the hydropower sector allows for clean energy production, and often for several decades, many of its impacts tend to be reduced with time. This was the case with mercury contamination in Northern Quebec. There ecosystems were not destroyed, they were transformed. After approximately 15 years, their biological productivity became comparable to that found in undisturbed natural environments (Hayeur, 2001). In fact, there are good and there are bad hydroelectric projects. That is the case irrespective of their size, even if there tend to be fewer impacts per TWh with a large project than there are with several smaller projects. The "small is beautiful" dogma and the fact that it is not with projects of the same output that comparisons are made have contributed to the unfavourable bias of many towards large dams (Drapeau, 1999). Nonetheless, hydroelectric projects are a good alternative to fossil fuel power plants (Lefebvre et al, 2004).

A « green » power option, victim of its virtues

The hydropower sector is a victim of the fact that it does not export its impacts, whether it be geographically or onto future generations: its impacts are here and now. This eminently sustainable energy option a victim of what is referred to as the «not in my generation» syndrome. Hydropower is also the only sector which allows us to provide clean energy to our descendants at an extremely low cost. The power plants often produce energy well beyond the return on investments period.

Today hydropower, tomorrow wind power?

Several of the objections to hydroelectric projects are now being echoed by the growing wind power opposition movement: their aesthetic aspect, denaturalization of the landscape, impacts on the fauna, etc. In Quebec, a massive development of wind power combined with a halt in the development of hydroelectricity would result, among other impacts, in a rise in the fluctuations of river flows (Bélanger et al., 1998). However, a key argument made by opponents to hydroelectric projects consists of relying exclusively on energy efficiency, wind and solar power. Those who were told that it was unacceptable to alter landscapes for hydroelectric development may be in for a surprise when they see 160-meter high towers erected close-by…

Systematic obstacles to the development of green energy

The theoretical potential of renewable energy development is very high, as is the technical potential for carrying it out. Financial constraints reduce this potential, but not as much as the notion of acceptability on social and environmental levels, in addition to the recognition of their ecological nature. Finally, the mentality often referred to as « not in my backyard » frequently puts a halt to those projects, even in the case of wind power.

A sustainable Kyoto strategy must include hydropower

To contribute to sustainable development means to accept manageable impacts, whether it be those of hydropower or those of other renewable energies, in order to achieve a truly low-carbon economy. Indigenous communities could become examples for Humanity, by contributing to the implementation of hydroelectric projects, and by coupling traditional knowledge with important efforts in order to assuage the environmental impacts of such projects (including projects such as Wuskwatim in Manitoba and Eastmain-1- A and Rupert diversion, in Northern Quebec).

Eliminating coal, reducing oil consumption and reducing one's dependence on the car should all be pillars of an effective GHG emission reduction strategy. This not only implies an increase of energy efficiency efforts, but also a massive development of renewable energies including hydropower, wind and solar energy. The hydropower plant with reservoir is the only renewable option which is not inherently intermittent. In countries where the resource is available, it must become the backbone of an energy production strategy geared towards renewable energy. Admittedly, it is necessary to integrate local populations, as much as possible, and to mitigate the environmental impacts of the projects. But to exclude, from the outset, hydropower from the implementation of the Kyoto Protocol is not only short-sighted, but irresponsible and unfair.

Founded in 1989, the GRAME is an NGO based in Montreal. Its missions is to promote sustainable development practices while taking into account macro-ecological stakes, particularly that of climate change. It seeks to achieve this objective through the promotion of renewable energy, sustainable transport, energy efficiency measures and the use of economic incentives used for environmental purposes. http://www.grame.org ●

UN Millenium Goals: why and how water matters

During the 2005 World Summit of the United Nations General Assembly on 14 – 16 September 2005, the following Millennium Development Goals (MDG) were presented to promote achievement by 2015. Each Goal is described in detail and has several targets, which can be viewed at: www.un.org/millenniumgoals.

1 Eradicate extreme poverty and hunger
2. Achieve universal primary education
3. Promote gender equality and empower women
4. Reduce child mortality
5. Improve mental health
6. Combat HIV/AIDS, malaria and other diseases
7. Ensure environmental sustainability
8. Develop a global partnership for development

The UN goes on to illustrate how important management of the world's water resources development is important in achieving these goals. Here are three direct quotes:

"Why do water resources management and development matter?

Water as a resource is an essential ingredient to virtually all the Millennium Development Goals. Although the Goals and their related targets focus principally on ends rather than means and therefore do not explicitly recognize the importance of water for food security or environmental sustainability, good water management and development will be essential to meeting the MDG's as a whole. Moreover, efforts to make the Goals a reality on the ground will require mitigation of potentially negative effects on many water resources and reconciliation of potentially conflicting demands on the same water resources

Water as a resource for agriculture, energy, transport, and industry is essential to fighting poverty and hunger. Water is an important factor of production in a variety of industries crucial to economic development and poverty reduction; it is also central to the livelihood systems of the rural poor."

Earlier, in October 2004, the Beijing Declaration on Hydropower and Sustainable Development has recognized that dams used to generate electricity had a "strategic importance for sustainable development". ●

Arthur Waltz, ICOLD Vice-President and Chairman
of the Public Awareness and Education Committee

Future water supply reduced with global warming, says new study; what can be done ?

San Pablo de Consolacion, Honduras: Elsie Fatima Rodriguez and Priscilla Rodriguez Alberto carrying home water from the traditional (unsafe) water hole for their families. Even those unsafe sources of water are now threatened by the lowering of water tables.
Photo credit: Dave Sarr, WaterPartners International

If global warming makes glaciers smaller and reduces annual snow pack, communities relying on these sources for fresh water likely will face serious shortages, according to research published in the journal *Nature,* November 17.

Researchers at the Scripps Institution of Oceanography at the University of California, San Diego, and the University of Washington conducted the work with backing from the U.S. Department of Energy and the National Oceanic and Atmospheric Administration.

In a warming climate, the scientists predicted that more water will fall as rain than currently falls as snow. Existing reservoirs will fill to capacity earlier than they now do in the spring. What snowmelt there is also will rush down mountain streams earlier than it currently does, exceeding the capacity of reservoirs, according to their predictions.

Communities that currently rely on a long, slow snowmelt for summer's water supply -- such as those in the North American West -- will face shortages, the study concluded.

In analyzing several scenarios, Scripps Institution's Tim Barnett, and Jennifer Adam and Dennis Lettenmaier of the University of Washington, show that human-produced greenhouse gases, and the resulting warmer climates they produce, will have a significant influence on ice- and snow-dependent regions and will result in costly disruptions to water supply and resource management systems.

In fact, the authors argue that their predictions and observations "portend important issues for the water resources of a substantial fraction of the world's population."

Scientist Tim Barnett, from the Scripps Institution of Oceanography at the University of California, San Diego.

The analysis first describes how water resource levels will change under global warming's influence and then depicts impacts on regions in the western United States, Europe, Canada, Asia and South America.

Not enough dam capacity

According to the authors, the forces driving these changes—described as «greenhouse physics»—show that in a warming climate more water will fall in the form of rain rather than snow, filling reservoirs to capacity earlier than normal. Additionally, a warming climate will result in snow melting earlier in the year than in previous decades, disrupting the traditional timing of water available from snow runoff streams. Together, they say, these changes mean less snow accumulation in the winter and earlier snow-derived water runoff in the spring, challenging the capacities of existing water reservoirs. According to Barnett, water shortages will occur in areas where reservoir capacity cannot hold the annual cycle of rain/snow.

«California, and in particular the Columbia Basin, doesn't have enough dam capacity to hold a seasonal cycle of water,» said Barnett. «When you change the seasonality of how rivers flow you are essentially putting the water runoff all into spring rather than being able to draw it out through summer. Mother nature is not going to act like a reservoir as it has in the past and when the water comes out all at once there isn't enough capacity to contain it.»

For Canada, the authors say earlier spring water runoff will threaten agricultural production in the Canadian Prairies. In Europe, hydrological simulations show that climate warming in the Rhine River Basin may reduce peak-demand water availability for industrial applications, agriculture and household uses. Ship transportation, flood protection, hydropower generation and revenue from skiing all could be threatened as a result.

In 2001, Barnett and other scientists with the Accelerated Climate Prediction Initiative estimated that vital water resources derived from the Sierra Nevada may suffer a 15- to 30-percent reduction in the 21st century as a result of changes in snowpack runoff.

The authors of the new study extended these ideas to regions that heavily depend on glacier-derived water for their main dry season water supply. Such regions contrast with those that depend on water derived from snowpack, such as the western U.S., where water supplies are replenished each year. Thus, the researchers warn that «even more serious problems may occur» in glacier dependent regions «because once the glaciers have melted in a warmer world, there will be no replacement for the water they now provide.»

Barnett, Adam and Lettenmaier say the most vulnerable region where vanishing glaciers will impact water supplies in the coming decades is China, India and other parts of Asia because of their potential to affect vast populations throughout this region. The ice mass in the mountainous area of this region is the third largest on Earth following Arctic-Greenland and Antarctica.

In South America, a significant fraction of the population west of the Andes Mountains similarly could be at risk due to shrinking supplies of glacier-derived river water. Glacier-covered areas in Peru, for instance, have experienced a 25 percent reduction in the past three decades, the authors note, and «at current rates some of the glaciers may disappear in a few decades, if not sooner.» Here again they warn that fossil water lost through glacial melting will not be replaced in the foreseeable future.

Distribution of global runoff is highly uneven and corresponds poorly to the distribution of the world population (see table 2). Asia has 69% of world population but 36% of global runoff. South America has 5% of world population, 25% of runoff.
Much of runoff is inaccessible. Amazon River accounts for 15% of runoff and is currently accessible to 25 million people (0.4% of world's pop). Estimate it to be 95% inaccessible. Zaire may be 50% inaccessible. The mostly untapped northern rivers have an average annual flow of 1815 km^3/yr, considered 95% to be inaccessible. Together, this amounts to 7774 km^3 or 19% of total annual runoff, leaving 32,900 km^3 geographically accessible.

Continental Breakdown of Share of Global Runoff and Population

Region	Total river runoff (%)	Share of global river runoff (%)	Share of global population (%)
Europe	3,240	8.0	13.0
Asia	14,550	35.8	60.5
Africa	4,320	10.6	12.5
N & C America	6,200	15.2	8.0
S America	10,420	25.6	5.5
Australia& Oceania	1,970	4.8	0.5
Totals	40,700	100.0	100.0

Dams offer double benefit

Of course, it should be kept in mind that human induced climate change mechanism is far from being scientifically understood and that all those predictions are based on climate models. Those climate models are full of weaknesses and uncertainties. Nevertheless, the warming has been observed be it natural or human induced. It is therefore wise to apply the «precautionary principle».

«Climate warming is a certainty in our future and the bottom line in this analysis is that we looked at the impact of the warming and the long-term prognosis is clear and very dire,» said Barnett. «It's especially clear that regions in Asia and South America are headed for a water supply crisis because once that fossil water is gone, it's gone.»

«If the snow pack melts sooner, and if societies don't have the ability to catch all of that water, they're going to end up with water shortages in the summer,» Dr Barnett explained to BBC. Well, there is a possibility for societies which do want to catch the water and not be submitted to such dire previsions : dams' building. There are already plenty of good reasons for building dams, from clean and cheap electricity to food independence. That's another new one.

Jenny Adam researched manmade reservoirs in the target region and found that the vast majority do not have the capacity to store the extra, early runoff. «We were surprised how many places [lacked extra capacity]», Barnett explained to National Geographic: «[Reservoirs] were built on the assumption that … water availability throughout the year wouldn't change.» It should be remarked first that the vast majority of those dams were built or planned long before any discussion of climate change happened. Moreover, the height of a dam, which commands the storage capacity, is not decided only on the envisioned needs, but mainly on other criteria: topographical possibilities, proximity of cities, etc.

Today, in any case, dams offer a double benefit solution to this problem : they can prevent climate change (by generating electricity without greenhouse gases emissions, contrary to the coal plants which generate 50% of the world electricity) and mitigate the possible consequences of climate change, by offering a regulating capacity. The dams are already now contributing to regulate the river's flow, to lessen the impact of floods and to insure a minimum flow during the low water period. The effects of climate change will make this unique role more necessary than ever.

ICOLD Board meeting in Paris

The Board meeting has met in Paris on April 20th and 21st. The Board is composed of eight ICOLD Officers : the President, the six Vice-Presidents and the Secretary General-Treasurer of ICOLD. Together, they reviewed and updated ICOLD's strategic plan and business plan.

Among the various matters that have been discussed, it is interesting to single out the implementation of ICOLD's multiyear strategic plan. The first key focus area is to "enhance ICOLD's reputation as leading professional organization for dams".

For improving the balance in the international debate about dams, ICOLD has launched a debate on the relevancy of the UNEP/DDP process, in order to prepare a position paper, which is now in discussion.

The Board meeting in Central Office: from left to right, Vice-Presidents Andy Hughes, Christo Abadjiev, Adama Nombre, Yong-Nam Yoon, Secretary General Michel de Vivo and President Cassio B. Viotti.

ICOLD participation in WWF-4

On the same subject, two ICOLD Officers participated to the fourth World Water Forum in Mexico, last March. They have made many contacts with representatives of other international organizations, including financial institutions.

ICOLD participated and made presentations in two sessions and SPANCOLD presented a third session. The sessions that ICOLD participated in were "Water Infrastructure for Sustainable and Equitable Development" and "Ensuring Dams are a Platform for Growth and Sustainable Development". SPANCOLD convened the session on "Role of Dams and Reservoirs in Integrated Flood Management".

President Viotti set the stage in his Key Message for the Forum outlining the role of dams in water and energy resources development and management. He outlined ICOLD's vision of sustainable development. He was not able to travel to Mexico for health reasons.

The election for the new Board of Governors pf the World Water Council has been held on March 15th in Mexico. It is composed by 35 elected members voted by the

General Assembly (the 36th governor is automatically attributed to the host city, Marseille), as representatives of the Council's membership.

The WWC membership (about 300 organizations) has been categorized under 5 'colleges' representing the main water stakeholders. Each of the colleges has between 4 and 9 members elected to the Board, according to the number of active members within that college.

ICOLD has been successfully elected, with the highest score, in 'College 5 - Professional associations and academic institutions' (9 seats for 21 candidates). Turkey has been elected as the host country for the 5th WWF of 2009.

Further, ICOLD has decided to push forward its strategic alliance with other organizations (IWRA, ICID, IHA…) and with international financing institutions.

Keeping the same objective in mind (enhancing the ICOLD's reputation as the leading professional organization for dams), President Viotti has insisted on the necessity of improving ICOLD's supportive role for lesser developed countries. ICOLD has thus initiated a project for capacity building for developing countries. The idea is to train engineers and professionals from developing countries on a short-term basis, from three weeks to six months. To implement the project, ICOLD's Board has negotiated and obtained funding from Sweden and agreements for training engineers in Turkey and Morocco.

The expenses (training costs, living expenses, local transportation, insurance…) are all covered. The only expense which must be covered by the national committee of the trainee is the travel expenses from the trainee's home country to the training site. The candidates will be selected on their motivation, age, language skill and on the impact their training could have for the development of water and energy resources in their country of origin. The topic of the training will be chosen by the President of Africa Australasia club of ICOLD in coordination with the Central Office and the host committee.

Improved Management of ICOLD

Within this general matter, we find many subjects, from the organization of ICOLD Executive meetings to the improvement of ICOLD's accounting system. Most importantly, the Members of the Board have decided to submit to the next Executive meeting the creation of a Constitutional Committee, which will be in charge for further revisions of ICOLD Constitution and By-laws. They also plan to establish the financial and advisory special Committee, which should help improving the functioning of ICOLD and ensuring ICOLD's financial sustainability. ●

Entertaining in a parisian restaurant after a long day of meeting. A. Walz, Mrs. Hughes, A. Hughes, Jia Jinsheng, C. Viotti and M. De Vivo.

A new Secretary General takes office

A new Secretary General has taken office at ICOLD Central Office. Michel De Vivo, 47, has been elected during the 73rd annual meeting in Teheran. A graduate Mechanical Engineer, he got also a further training in management and followed the special Banque of France training in financial analysis.

His professional life has taken him from a range of posts in the engineering and operation of hydro plants in the south-eastern part of France to overseeing major powerplant rehabilitation programmes in various African countries as well as in a turbulent region of the Middle-East.

Michel De Vivo has a large international experience in Lebanon, where he lived for one and a half year, and in Mali, where he got several three-month assignments. He also visited, for a variety of assignments, Morocco, Sudan, Togo, Benin, Ivory Coast, South Africa, Democratic Congo, Madagascar…

Interviewed in Hydrower & Dams, he said about his new office: "The job entails all the things I appreciate most : building relationships between people to encourage an international dialogue and exchange of experience; challenges of management and administration; and, perhaps above all, the possibility to extend the knowledge base of ICOLD to some of the less developed countries."

Michel De Vivo feels fortunate to have joined ICOLD at a very good time, with a new era clearly beginning for dam projects. He comments that the recent decision of the World Bank and Asian Development Bank to support Nam Theun 2 in Laos demonstrates the very marked renewal of interest around the world for large dams. Prospects are thus very favourable for dams, hydropower and for ICOLD, he feels.

Michel De Vivo is married and has two children. He speaks French, English and Italian.

AGENDA

June 14-23 2006
Barcelona, Spain

ICOLD 74th Annual Meeting and
22nd Congress

Unlike most of the European countries, Spain has still a lot of design and construction going on in the fields of water management and hydroelectricity. For this reason, it will be interesting to present the experiences of a developed Southern European country. Due to the high irregularity of the rivers, many large dams have had to be constructed, in order to advance in water management processes, taking into account the environmental aspects and European Union laws, related to the use of natural resources within sustainable development. In the Study Tours that will take place before and after the Congress, the participants will have a chance to visit important dam projects in Spain and Portugal, as well as its very diverse scenery and cultural and artistic heritage.

During the Congress four technical questions will be debated :

QUESTION 84:
Technical solutions to reduce time and costs in dam design and construction.

QUESTION 85:
Management of the downstream impacts of dam operation

QUESTION 86:
Safety of earth- and rockfill dams.

QUESTION 87:
Flood and drought evaluation and management.

More information:
http://www.icold-barcelona2006.org

31 July - 4 August 2006
Portland, Oregon, USA

HydroVision 2006

HydroVision 2006 is actually seven conferences in one. Concurrent sessions are organized into easy-to-follow «tracks» each of which addresses a wide range of topics within its subject area.

Track A: Asset Management
Track B: Civil Works/Safety
Track C: Policy, Licensing, and Implementation
Track D: New Development
Track E: Operations and Maintenance
Track F: Water Resources Management
Track G: Technical Papers

More info:
http://www.hcipub.com/hydrovision/index.asp

September 25-26, 2006
Porto Carras, Greece

Hydro 2006

A practical exchange of knwoledge and experience on planning processes, project finance, design criteria, design tools, construction techniques, maintenance and upgrading, will help to accelerate future hydropower development.

Speakers at Hydro 2006 will discuss the direct and indirect benefits of hydropower, its synergy with other renewables, ways of improving economics through prudent planning, and the use of advanced technology for design, construction and refurbishment. New approaches to financing, environemental and social issues will be high on the agenda.

The need to maximize the benefits of existing hydro plants worldwide is the main theme of HYDRO 2006. This includes getting the most out of existing assets by adopting new decision-making tools and O&M procedures, as well as taking full advantage of the multiple benefits of hydro, and implementing timely upgrading.

More info:
http://www.hydropower-dams.com/hd_67_0.htm

Contact: mb@hydropower-dams.com

November 2-24, 2006
Vienna, Austria

14th International Seminar on
Hydropower Plants
Worldwide use of Hydropower in the Future

The objective of the Seminar is to provide a forum for exchanging information and ideas and presenting new developments in various fields of Hydropower.

As renewable and sustainable systems become more and more important at our present energy situation, new technologies have to be found and older ones improved. Research, development and refurbishment modernization work are the opportunity for the future. All contributions to the above topic, which lead to an active experience-exchange are welcome.

- Hydropower potential, Use of Energy worldwide and legal framework
- New technologies, Design and research of hydraulic components
- Production methods and materials
- Sustainability and social impacts of Hydropower plants
- Projects and Plant management

More info:
http://info.tuwien.ac.at/wup/tagung2006/

The Dams Newsletter is published
by ICOLD-CIGB,
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151 boulevard Haussmann
75008 Paris
Tél. : *(33) 1 40 42 68 24*
Fax : *(33) 1 40 42 60 71*
Editor : Michel de Vivo
Managing Editor :
Emmanuel Grenier
Layout : Daniel Couvidat
Printer : Montligeon, 61400
ISSN number in progress