Tri An Hydropower Plant in the South Vietnam, 400 MW power capacity, 2.7 km^3 water storage reservoir

The ICOLD Committee on "Dams for Hydroelectric Energy" -

Some topics discussed at the Committee Meeting in Sofia 2008

(Mr. Giovanni RUGGERI, Chairman of the Committee)

Hydroelectric power plays an important role in the response to the energy needs, supplying about 715000 MW (about 20% of the total) of clean and renewable energy.

- Collection, review and discussion of synthetic data about:
  - Electricity demand and production
  - Contribution of renewable energies
  - Role of hydro production

  Evolution in time, current situation, geographical distribution, current trends, ...- Examples are given in Section1

  Note: Data age rapidly, emphasis should therefore be given to rather global data and long term trends.

- Future Scenarios:

  Long term IEA (Int. Energy Agency) scenarios to 2050 based on existing and near-commercial technologies.

- IEA 2006 “Reference Scenario”, in which renewables will only constitute 13.8% of world primary energy demand by 2030
- IEA 2006 “Alternative Policy Scenario” in which renewables share rises to 16.2%, assuming the implementation of policies currently being considered by governments to ensure energy security and reduce CO_2 emissions.

Some 8200 large dams are currently in operation having hydropower as main or sole purpose.

- Collection, review and discussion of synthetic data about:
  - Hydropower plants (sources: IHA, specialized magazines, etc.)
  - Dams for hydroelectric purpose (source: ICOLD World Register of Dams)

  Evolution in time, current situation, geographical distribution. (see examples in Sect. 2). Current trends (plants/dams in construction/design/planning stage)

It’s therefore a clear interest to analyse and promote the development of sustainable hydropower dams.

- Discussion about the contribution of renewables to energy security

  The environmental benefits of renewable energy is well known, but its contribution to energy security is less widely recognized (“security”: “uninterrupted physical availability of energy products on the market, at a price which is affordable for all consumers”).

  Security risks: incapacity of the electricity infrastructure to meet growing load demand; threat of an attack on centralized production structures or transmission grid; global oil supply restrictions resulting from political actions.

  Renewables can reduce geopolitical security risks by contributing to fuel mix diversification and can reduce the variability of generation costs. In addition, indigenous renewables reduce import dependency. A broad portfolio of renewable energies (hydro, geothermal, bioenergy, wind, solar, ...) can provide more security.
  Large-hydro/geothermal/bioenergy offer comparable level of firm capacities of conventional fossil fuel plant, while solar/wind/small-hydro are more variable.

The fast response time of hydro reservoirs can meet sudden fluctuations in demand, help compensate for the loss of other power supply options, provide built-in energy storage which assist the stability of electricity production across the entire power grid
(ref: IEA Information paper).

The role of pumped-storage plants

Role of dams and reservoirs in sustainable hydropower.

The Role of Hydropower in the Energy Market; Potential for new hydro generating capacity; "Hydrodiversity"; Hydropower: the backbone of an integrated renewable grid; Small hydro: a response to specific needs; The Sustainable Development Dimension of Hydropower;
Ref: IHA White Paper (2003); IHA Sustainability Assessment Protocol (2006)

Case histories.

See examples of added value created by hydropower projects reported in the IHA White Paper.

Prospects of the hydroelectric energy for the development and for the achievement of environmental targets defined at international level (Kyoto protocol, European directives, etc.). Policies and programs to promote hydroelectric production in the context of renewable energies.

Implication for HPP from recent policies intended to mitigate climate change.
Green certificates.
Current incentives for renewable energies: Differences approach to large and mini hydro?; Specific attention to "small hydro"?; Large hydro is included?
Current situation, evolution/modification with the time, positive/negative remarks, ...

New additional uses, demands and multipurpose requirements for reservoirs originally dedicated to hydroelectric power only, and their incidence on power production.

…. …. ….
… … ….

Incidence of dams and reservoir ageing, including silting management, on the full exploitation of hydroelectric plants.

Useful reference for siltation: ICOLD Bulletin by the "Sedimentation Committee" (see example in Section 3).

Pumping hydroelectric plants. Role, importance and perspective in the context of power production

Data from the "World register of Dams" or other sources (hydropower magazine), synthesys of the data of main interest. Plants under construction, under design, planned, ...;
Siting and capacity optimization;
Integration of wind and other renewable technologies .

Specific technical aspects related to the pumping use of the reservoir.

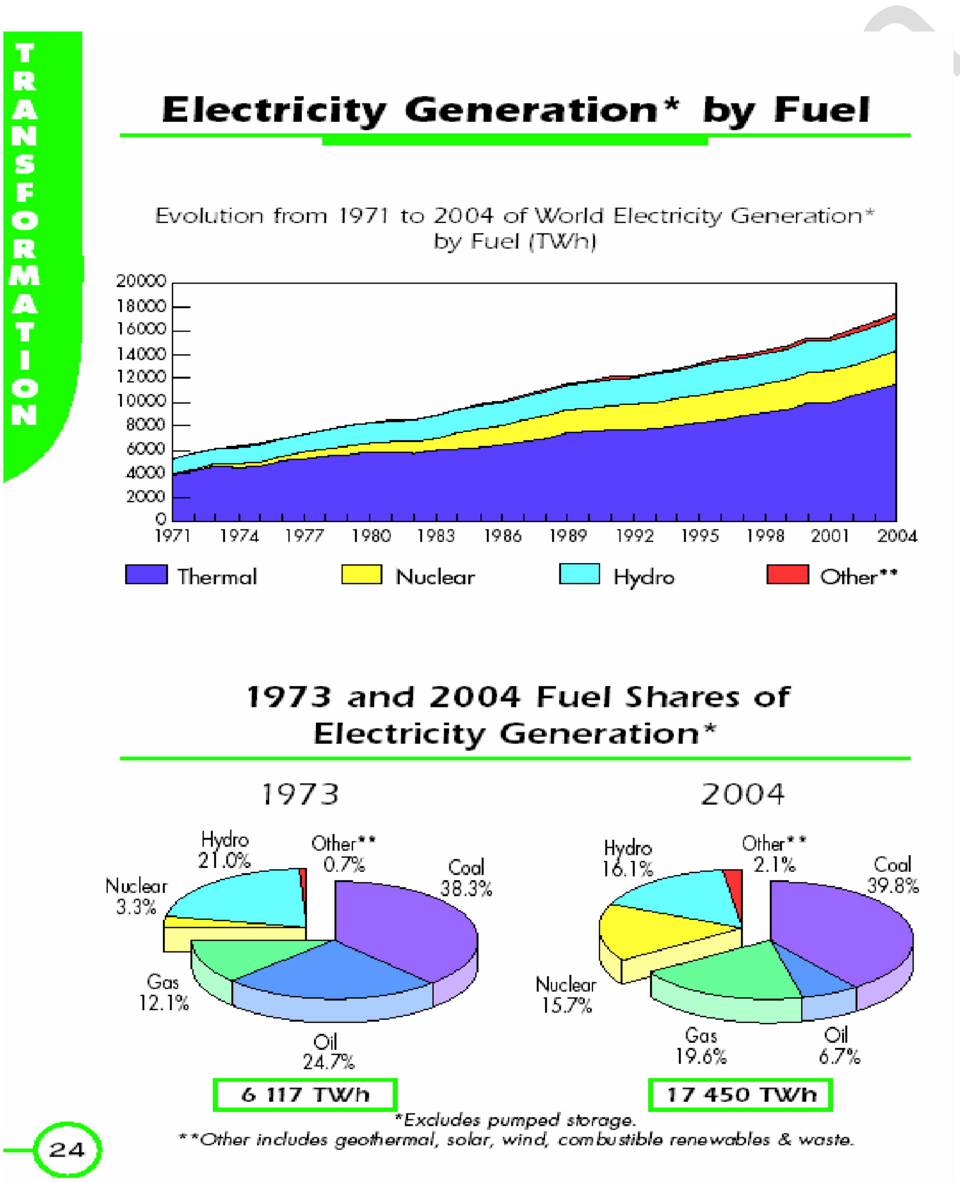
Monitoring techniques (daily cycles).
Most recurring degradations/ageing phenomena; Case histories.
Most recurring incidents/problems; Case histories.

Other topics?

Relationships with other association operating on the subject ??: IHA (Int. Hydropower Ass.), ISHA (Int. Small Hydropower Ass.), ...

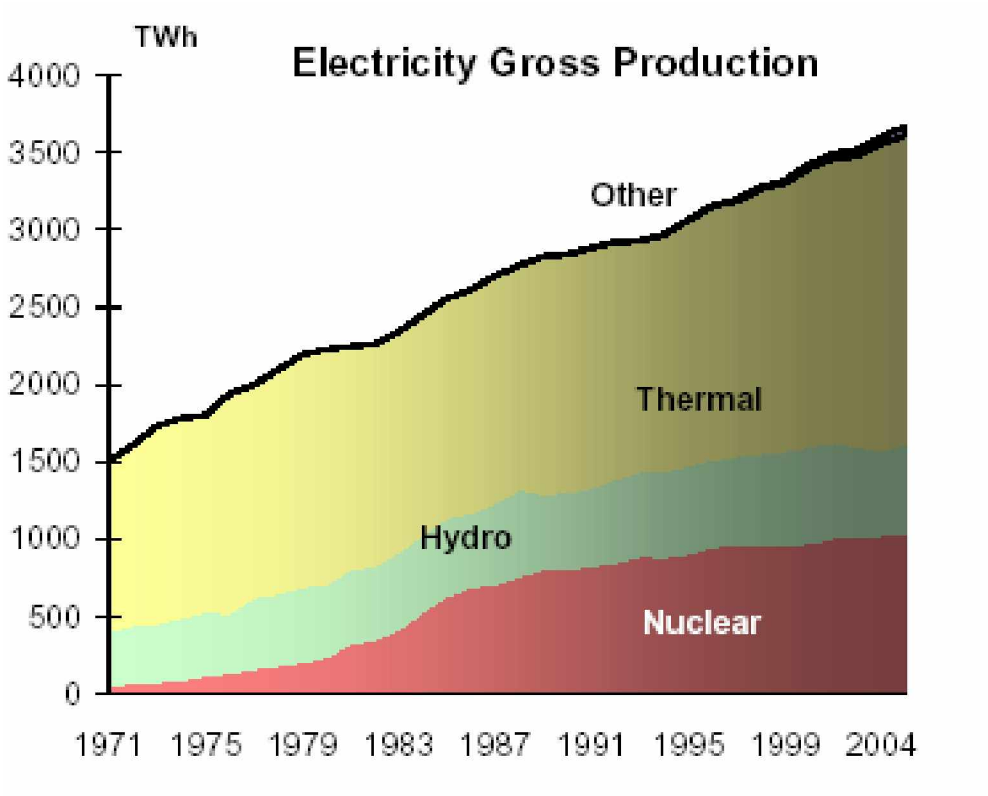
Section1 - Examples

COMPOSITION OF GLOBAL FINAL ENERGY DEMAND	
ELECTRICITY	: 17%
LOW TEMPERATURE HEAT	: 44%
HIGH TEMPERATURE IND. PROCESS HEAT	: 10%
TRANSPORT FULES	: 29%



Section1 - Examples

EUROPE



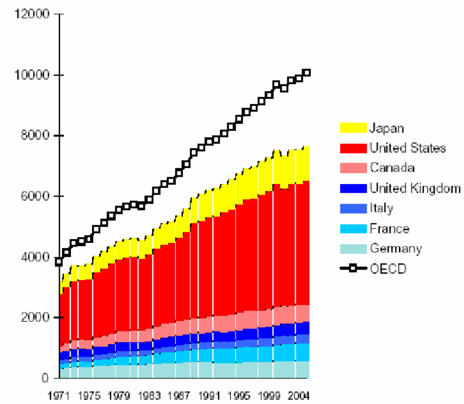
EUROPE

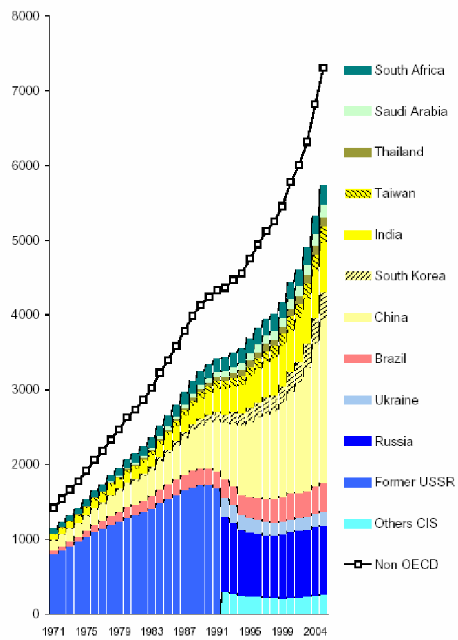
Electricity (TWh)	1999	2000	2001	2002	2003	2004
Gross Production	**3 321,3**	**3 424,8**	**3 494,0**	**3 519,1**	**3 603,9**	**3 671,9**
-Nuclear	969,2	971,4	1 005,6	1 017,1	1 021,9	1 033,6
-Hydro	603,9	625,0	621,1	580,4	549,9	587,6
-Thermal	1 726,7	1 797,9	1 832,4	1 877,6	1 980,7	1 992,0
-Wind	14,25	22,32	26,87	35,80	42,45	53,99

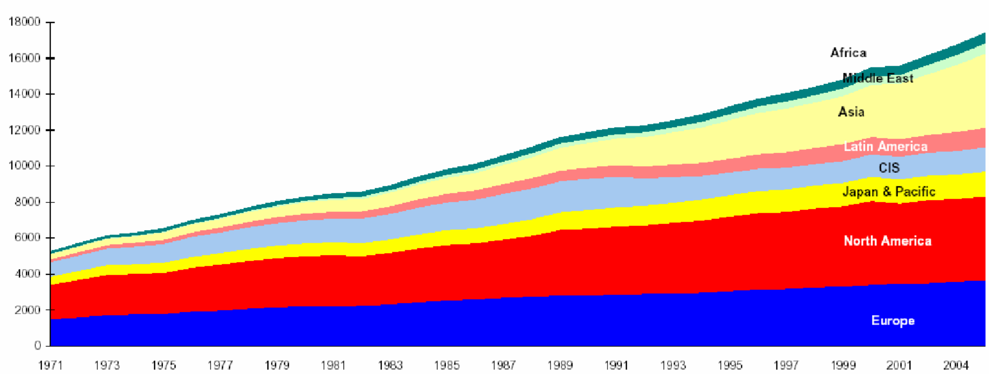
Energy Statistics Yearbook, ENERDATA® , June 2005

Production of Electricity

(TWh)	1999	2000	2001	2002	2003	2004	04/03
France	524,0	540,7	550,5	560,1	566,9	572,2	0,9
Germany	554,1	571,4	586,3	571,6	593,1	595,8	0,4
Italy	265,7	276,6	279,0	285,3	292,8	302,5	3,3
Poland	142,1	145,2	145,6	144,1	151,8	154,9	2,1
Spain	208,5	224,5	236,0	246,1	262,9	276,8	5,3
Sweden	154,9	145,3	161,6	146,1	135,1	151,3	11,9
United Kingdom	368,2	377,1	384,7	387,1	398,6	400,0	0,3
European Union	**2 848**	**2 927**	**3 009**	**3 020**	**3 109**	**3 164**	**1,8**
Norway	122,7	140,1	119,7	130,6	107,3	110,4	2,9
Europe	**3 321**	**3 425**	**3 494**	**3 519**	**3 604**	**3 672**	**1,9**
Canada	578,9	605,6	589,8	601,5	583,8	580,0	-0,6
United States	3 897	4 052	3 865	4 018	4 011	4 083	1,8
North America	**4 476**	**4 658**	**4 455**	**4 619**	**4 595**	**4 663**	**1,5**
Australia	203,4	207,8	217,2	222,2	228,8	236,1	3,2
Japan	1 066	1 092	1 076	1 097	1 084	1 110	2,4
Japan & Pacific	**1 308**	**1 338**	**1 333**	**1 360**	**1 354**	**1 389**	**2,6**
Russia	846,2	877,8	891,3	891,3	915,3	931,0	1,7
Ukraine	172,1	171,4	173,0	173,7	179,6	181,2	0,9
CIS	**1 211**	**1 248**	**1 267**	**1 273**	**1 315**	**1 338**	**1,7**
Argentina	80,7	89,0	90,2	84,5	93,3	101,2	8,5
Brazil	334,8	349,2	327,9	344,6	363,9	383,0	5,2
Mexico	192,3	204,4	209,6	215,2	221,3	210,2	-5,0
Venezuela	80,6	85,2	90,1	87,4	89,8	96,4	7,4
Latin America	**930**	**979**	**969**	**997**	**1 044**	**1 077**	**3,1**
China	1 239	1 356	1 472	1 640	1 907	2 182	14,5
India	534,5	560,8	579,1	596,5	626,5	659,1	5,2
Indonesia	84,3	92,6	101,6	108,2	113,0	123,8	9,6
South Korea	237,8	265,3	283,3	329,0	347,3	368,6	6,1
Taiwan	173,3	193,0	196,6	207,2	217,3	227,0	4,4
Thailand	90,0	96,0	102,4	109,0	117,0	125,2	7,0
Asia	**2 676**	**2 901**	**3 090**	**3 365**	**3 733**	**4 129**	**10,6**
Iran	112,7	121,4	130,1	140,8	152,8	163,5	7,0
Saudi Arabia	120,0	128,4	137,4	145,6	161,0	170,8	6,1
Middle East	**435**	**463**	**488**	**518**	**551**	**578**	**4,8**
South Africa	203,2	210,7	212,0	220,4	234,2	244,6	4,4
Africa	**421**	**441**	**457**	**479**	**507**	**532**	**4,8**
OECD	**9 327**	**9 683**	**9 556**	**9 819**	**9 887**	**10 066**	**1,8**
World	**14 778**	**15 455**	**15 553**	**16 131**	**16 703**	**17 373**	**4,0**





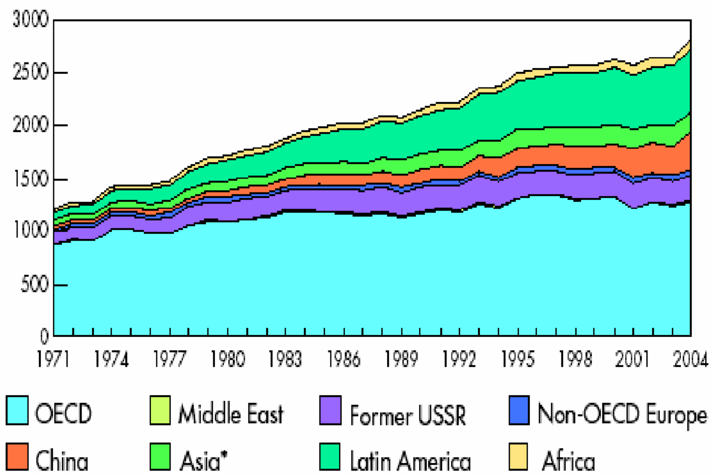


Energy Statistics Yearbook, ENERDATA®, June 2005

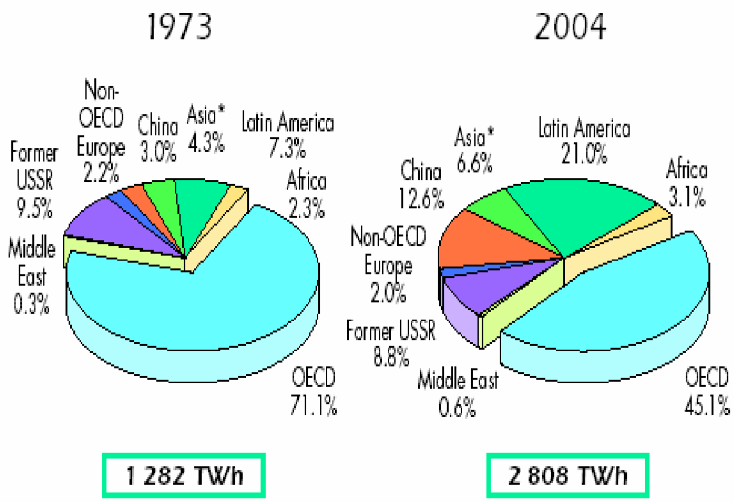
SUPPLY

Hydro Production

Evolution from 1971 to 2004 of Hydro Production by Region (TWh)



1973 and 2004 Regional Shares of Hydro Production



*Asia excludes China.

Producers of Hydro Electricity

Producers	TWh	% of World total
People's Rep. of China	354	12.6
Canada	341	12.1
Brazil	321	11.4
United States	271	9.7
Russia	176	6.3
Norway	109	3.9
Japan	94	3.3
India	85	3.0
Venezuela	70	2.5
Sweden	60	2.1
Rest of the World	927	33.1
World	**2 808**	**100.0**

2004 data

Installed Capacity (based on production)	GW
United States	99
People's Rep. of China	86
Canada	67
Brazil	59
Japan	46
Russia	44
India	30
Norway	28
France	25
Sweden	16
Rest of the World	307
World	**807**

2003 data
Sources: United Nations, IEA.

Country (based on first 10 producers)	% of hydro in total domestic electricity generation
Norway	98.8
Brazil	82.8
Venezuela	71.0
Canada	57.0
Sweden	39.6
Russia	18.9
People's Rep. of China	16.1
India	12.7
Japan	8.8
United States	6.5
Rest of the World*	14.2
World	**16.1**

2004 data

* *Excludes countries with no hydro production.*

Section 2 – Example

Specific Country data??

Bilancio dell'energia elettrica in Italia. Anni 2002-2003-2004 (GWh)

	2002	**2003**	**2004**
Produzione idroelettrica	47.262	44.277	49.908
Produzione termoelettrica	231.069	242.784	246.125
Produzione geotermoelettrica	4.662	5.341	5.437
Produzione solare e fotovoltaica	1.408	1.463	1.850
Totale produzione lorda	**284.401**	**293.865**	**303.321**
Consumi servizi ausiliari	13.619	13.682	13.298
Totale produzione netta	**270.783**	**280.183**	**290.023**
Energia destinata ai pompaggi	10.654	10.492	10.300
Produzione netta al consumo	**260.129**	**269.691**	**279.722**
Importazioni	51.519	51.486	46.426
Esportazioni	922	518	791
Richiesta totale Italia	**310.726**	**320.659**	**325.357**
Perdite	19.766	20.870	20.868
Totale consumi	**290.960**	**299.789**	**304.490**

Fonte: TERNA Anno 2004

Section 3 – Example

POTENTIAL IMPACTS OF STORAGE CAPACITY FOR DIFFERENT RESERVOIR PURPOSES

After summing the regional growth rate curves to arrive at the global growth rate curve, it was found that hydropower dams made up 81.5 % of the worlds total current storage capacity. It was also seen that in 2006, 35 % of the total storage capacity for hydropower had been filled with sediment. In 2050 this proportion of current total capacity that would have been filled with sediment has risen to 70 % (Figure 15).

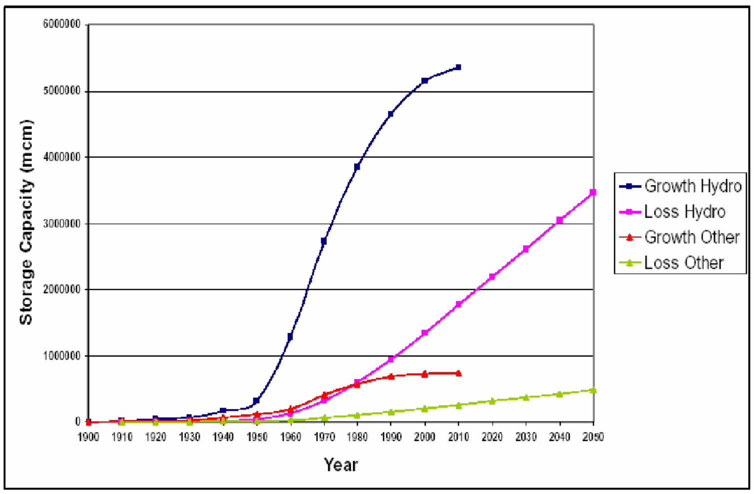


Figure 15 Global comparison of growth of dams by purpose

For dams for any other purpose (non-hydropower), in 2006, 33 % of the available capacity was filled with sediment, rising to a value of 62 % by 2050 which it is not as high as that for hydropower dams.

Hydropower dams

Hydropower dams can generally be filled with sediment to a higher level than non-hydropower dams, as it is mainly necessary to maintain the head for the power generation, and a storage capacity sufficient to meet all expected demands for power. It is expected that hydropower dams will be severely impacted when they reach a level of sedimentation of 80 %. Based on the global data this will occur by the year 2070, and per region as indicated in Table 2.

Table 2 Year current storage will reach critical sedimentation levels

Region	Hydropower dams: Date 80 % filled with sediment	Non-hydropower dams: Date 70 % filled with sediment
Africa	2100	2090
Asia	2035	2025
Australasia	2070	2080
Cental America	2060	2040
Europe and Russia	2080	2060
Middle East	2060	2030
North America	2060	2070
South America	2080	2060