WATER FOR ENERGY

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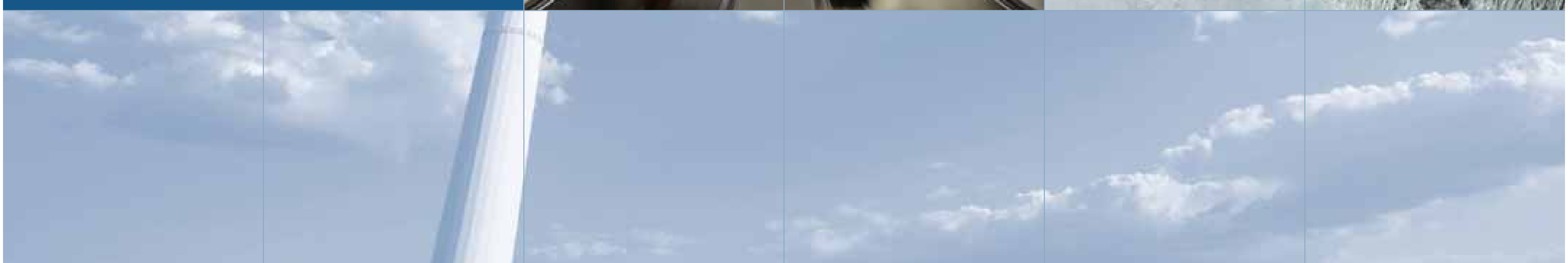
HUA HIN, THAILAND

Promoting sustainable energy for the greatest benefit of all



Use of Water for Energy

- Hydro Electricity
- Electricity Production
- Cooling Nuclear / Thermal Plants
- Requirement for Fuel Production

  - Bio-ethanol, Gasoline, Conventional Crude,

    Oil Sands, Coal

Use of Water for Energy

- Hydropower is the most important and widely- used renewable source of energy. It represents 16% of total global electricity production (3100 TWh – 850 GW in 2007).
- Hydropower is a major contributor to renewable energy production, representing 89% of worldwide production in 2002.
- There are now about 45000 large dams in operation worldwide in 140 countries.
- Only about 10% of dams have “hydropower” as their main use; considerably more dams have “irrigation” or “multi-purpose” as their main use.

Use of Water for Energy

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- It is estimated that two-thirds of the world's economically feasible potential is still to be exploited (only about 7% developed so far in Africa).
- Canada is the largest producer of hydroelectricity, followed by the United States and Brazil. With a theoretical potential of 700 GW, a potential reach of 600 GW, China is planning to double or even triple in a very short time the 150 GW installed today.
- Hydro schemes often have major positive impacts on social and economic local development in areas with water resources but with inadequate or no access to basic needs such as electricity.

Dams and the environment

- Hydropower is part of the solution as an existing low carbon technology.
- On one hand, artificial reservoirs emit greenhouse gases (GHG) like natural lakes and more generally ecosystems. It mainly occur in the first few years after impoundment and then taper off.
- On another hand, reservoirs and lakes sequester large amounts of carbon which finally tend to consider reservoirs as carbon-neutral. Emissions are higher for a small number of reservoirs in tropical areas but “net” emissions are significantly below fossil fuels.
- A hydropower plant generates no global pollutants such as sulphur and nitrogen oxides.

Dams and the environment (Social/Community)

- Hydro schemes, bring access to electricity, water for drinking and irrigation, roads, industry and commerce, developing the economy and enhancing quality of life of local community.
- In the case of large reservoir creation, the biggest social concern is the people who have been forced to move ("resettled") and have not been properly compensated.
- One approach to this issue is to fairly share the benefits among the stakeholders and to ensure that affected people are better off after the project is constructed than they were before.
- Experience has shown that anticipating and exploring impacts early in the planning process is critical, and allows appropriate steps to avoid, mitigate and compensate to be taken.

Water Requirements for Fuel Production

- Water is consumed at a rate of 2.8–6.6 liters for each liter of gasoline produced for more than 90% of crude oil obtained from conventional onshore sources in the U.S. and more than half of crude oil imported from Saudi Arabia.
- The total amount of water used in refineries has been estimated to an average 65–90 gallons of water per barrel of crude oil
- For more than 55% of crude oil from Canadian oil sands, about 5.2 liters of water are consumed for each liter of gasoline produced.

Water Requirements for Fuel Production

- Quantity of water required during different stages of coal development in principal coal-producing regions of the US and USSR suggested that roughly 1–2 tons of water will be consumed for every ton-equivalent (tce) of coal-fuel delivered. However, these estimates assume a high degree of water conservation; with less emphasis on conservation, perhaps 50% more water will be required.
- The amount of irrigation water used to grow bio fuel feedstock varies significantly from one region to another and varies with processing technology. Nearly 70% of U.S. corn used for ethanol is produced in regions where 10–17 liters of water are consumed to produce one liter of ethanol.

Water Requirements for Electricity Production

The table illustrates the simple change in water demand that results from the chosen cooling process. Once-through cooling systems require some 400 more water withdrawals than recirculation systems, but result in a consumption of only about one tenth to one fifteenth.

Fuel Source	Technology	Withdrawal (litres/kWh)	Consumption (litres/kWh)
Fossil	Once-through	142.5	0.38
Fossil	Recirculating	4.5	4.20
Nuclear	Once-through	174.6	0.38
Nuclear	Recirculating	5.7	5.70

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Water Requirements for Electricity Production

Cooling water requirements for each type of plant were calculated from NETL data and are tabulated as follows for "model" plants' consumption of fresh water:

Fuel and thermal cycle	Water requirements per unit of energy
Coal, once-through, subcritical, wet FGD	0.52 litres/kWh
Coal, once-through, supercritical, wet FGD	0.47 litres/kWh
Nuclear, once-through, subcritical	0.47 litres/kWh
Coal, re-circulating, subcritical, wet FGD	1.75 litres/kWh
Coal, re-circulating, supercritical, wet FGD	1.96 litres/kWh
Nuclear, re-circulating, subcritical	2.36 litres/kWh

Water demands for Energy to 2050

Asia

(Billions of water tons (km3) per year)

Primary production source	2005	2020	2035	2050
Coal, Lignite	19.25	24.32	28.84	36.73
Oil	20.33	19.13	17.81	16.90
Non-conventional oil	0	0	0	0
Thermal (combustion) electricity	2.64	4.47	6.21	8.26
Nuclear	0.01	0.23	0.81	1.70
Total	42.23	48.15	53.67	63.59

Water demands for Energy to 2050

World

(Billions of water tons (km3) per year)

Primary production source	2005	2020	2035	2050
Coal, Lignite	33	38.6	45	56.1
Oil	48.9	61.6	70.7	71
Biomass and wastes	43.7	57.7	78.9	109.8
Thermal (combustion) electricity	6.1	9.9	13.0	16.7
Nuclear	1.4	2.1	3.8	6.1
Total	133.1	169.9	211.4	260.2

Water for Energy in the Future

- One certainty is that developed nations face the need to reduce their carbon footprint, so as to develop a new high-quality standard that is more sustainable, and to inspire and encourage developing regions. It can be expected that such a new technological model of living, probably more intense than modern day use of renewable energy and recycling, will be developed with the view of creating a vast, global market.

Trends in Water for Energy

- Continued growth in electricity demand will require additional investment in power stations that need water for electricity generation. There is also the need of water for other power processes, such as the refining of energy products and the production of alternative fuels. It can be seen that a large portion of present day water for these uses is obtained from water recycling and, in general, from increasing the effectiveness of traditional water uses, such as agriculture. In some parts of the world some of this water is obtained from sea water desalination. This water demand will remain growing as emerging economies demand more energy products.

Trends in Water for Energy

- A very important factor to realise is that the most developed regions are registering great energy (and often, as well, irrigation water requirements) savings, while developing nations are demanding increasing amounts of energy and water.
- There is not a clear correlation between water available and the degree of development. On a closer inspection of water data, it can be seen that as a higher level of development is attained, the water required by irrigation diminishes, probably because industrial, urban and other water uses compete more successfully with agriculture than in developing countries. Development, it seems, is a promoter of water efficiency.

Summing up

- The increased competition for water is generating new ways of looking at the natural resources in a more integral fashion than before. Several analysts are addressing the simultaneous management of energy and water. A new systematic methodology is being developed for targeting and design that simultaneously minimizes the requirements of energy and water. Using this new approach, the design of a water system for maximum energy recovery can be achieved.

Summing up

- Water for energy in the future will follow the trends that energy demand shows, which means that a certain increase in the breath of the divide between developed and developing countries will occur.
- The only mechanism viable to produce increased investment in infrastructure for water efficient use and reuse is market development. There seems to be very little resources in developing regions to pay for infrastructure required with public funds.
- There is certain evidence in more progressive societies that market development of water efficient irrigation and treatment systems (including desalination) can occur without threatening government structure. It is foreseen that the increased collaboration among countries to consolidate their standards and compulsory directives will be preliminary to proper market development.

Summing up

- New technological challenges for water and energy are not only related to traditional infrastructure and equipment, but also to increased automation and remotely supervised systems, which require increased sophistication in technicians and engineering prowess.
- The complex nature of societies' challenges facing the water for energy future demands better scientific knowledge of issues involved, and better technology to tackle the ever more complex situations encountered. Knowledge will also be needed to increase in terms of the local values and traditions, social constrains and aspirations. As in many other aspects of human endeavor, the successful tackling of water for energy challenges will demand a very intense international debate and the building of trans national consensus, at the same time as improving local and country values and history

Thank you