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# Singapore at 50: Oil and Water - Inextricably Mixed Transcript

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## **Singapore at 50:**

### **Oil and Water - Inextricably Mixed**

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The world is facing a resource crisis. This arises primarily from the demands of a global population that is burgeoning and enjoys steadily improving standards of living. The resources that are most under pressure are energy and water. Not surprisingly demand growth is strongest in developing countries. It is particularly in those countries that people flock to the big cities making them even bigger and exacerbating problems of water and energy supply. Over the last 50 years, Singapore has faced many of the problems faced today by these new megacities and has developed strategies and technologies to deal with them. In this lecture I discuss the problems and their origin and how approaches developed in Singapore may be helpful elsewhere.

Water and energy are closely linked. Energy is needed both to treat water and to move it to where it is needed. Conversely, traditional power stations cannot operate without water which they need for cooling. Unfortunately, the most affordable and accessible form of energy for most of the world comes from burning fossil fuels. This releases into the atmosphere greenhouse gases that cause the Earth to retain more of the heat from the Sun. In turn this contributes to changes in the climate and where, when and how much rain falls. The main greenhouse gas released by burning fossil fuels is carbon dioxide - familiar in sparkling water and other drinks. A significant fraction of that CO<sub>2</sub> dissolves in the oceans and increases their acidity. The full consequences of this are not yet fully understood but there are strong indications that marine animals that have calcium carbonate in their shells or skeletons will suffer. Some of these, such as krill, underpin the oceanic food chain and thus much of marine life.

Because fossil fuels are highly valued it is economically viable to ship them for long distances to wherever they are needed. The same is not true of water. We are prepared to pay roughly a thousand times less for a litre of water than for the same amount of oil and we use much more of it. Water therefore is virtually always locally derived and transport distances are short. Historically it is water availability that largely determined where human settlements developed.

This means that the global water crisis is not truly global. Rather it is series of different local crises that have to be solved locally. The rapid urbanisation of the world population means in many cases that population growth has outstripped the growth of infrastructure and that there is not enough water to go round. In some places there is conflict between the needs of agriculture - responsible for around 70% of world water use - and those of the urban population. Locally the demands of industry, particularly power generation, may be hard to meet. Finally in addition to all these needs there are the silent needs of other plants and animals. Trees, plants, birds, insects and a host of other organisms comprise the wider environment without which we could not survive but which tend to be taken for granted. In some cases urban or industrial waste has polluted rivers to the extent that they are nearly devoid of life. In others, so much water has been extracted upstream that nothing recognisable as a river reaches the sea and there is no water to support life.

These problems are serious but if recognised and tackled early enough are not insoluble. Although a great deal of work is going into the development of new energy sources it looks inevitable that we shall be dependent on fossil fuels for some decades. Clearly the strategy should be to use these as sparingly as possible but as long as they are in use we should try to prevent their combustion gases from entering the atmosphere. For power stations and many other industrial plants this can be done by a group of technologies known collectively as carbon capture and storage (CCS). Although this is now operational in Canada, CCS is still in its infancy. Moreover, there must be substantial reductions in cost before it can be widely deployed, particularly in the developing world where the majority of new power stations are being built.

The problems of water are in some ways easier and in others more difficult than those of energy. Moving water in any quantity over significant distances is expensive and so water sources have to be local. On the other hand, however, water is never destroyed and so if it can be efficiently captured and cleaned there is no limit to the number of times that it can be used. As discussed below, this is an area of technology in which Singapore has become one of the world leaders.

As an island of a little over 700 km<sup>2</sup> and a population of over five million, Singapore is one of the most densely populated countries in the world. Although Singapore is not a megacity, its population density is more than that of most megacities and in some respects is a test bed for the technologies they need. The annual rainfall is around 2000 mm and much of it evaporates rapidly; even if all the residual water could be captured, it would be insufficient for the population and industrial needs. Singapore has therefore developed a water strategy that starts with efficient water use and the avoidance of waste. But that is only the beginning. The rainfall that is trapped in reservoirs is supplemented by recycling of processed waste water and by desalinating sea water. In spite of these developments some water has to be imported.

Through the agency of its Public Utilities Board, Singapore has demonstrated that both desalination and reuse processes can be operated efficiently on a large scale. Unfortunately these processes have an energy cost and reducing this is one of the main targets of research for both universities and the plethora of water technology companies that have been started in Singapore or are based there. Notwithstanding these achievements, none of this would have worked without the unglamorous but fundamental development of modern sewage system that protects public health by transporting, separating, and treating wastes thereby keeping the rivers clean.

Enlightened leadership in Singapore recognised early, however, that efficient and affordable basic utilities were not enough. A population also needed parks, lakes and other green spaces for recreation. These have been achieved by cherishing green areas and through an ambitious program of building reservoirs and catchments while at the same time planning for them to be used for recreation. Over the fifty years since Singapore was established, the transformation has been astonishing.

Humanity faces resource serious challenges but Singapore has demonstrated that although small in area, with sufficient determination, discipline and ingenuity it is possible to both make a significant contribution towards solving at least one of them and to enjoy a very high environmental standard of living at an extreme density of population. There are lessons for the rest of this crowded world.