OLD TECHNOLOGY FOR A NEW CITY

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As a reaction to your UNEP proposal that came across my desk on May 1, I wish to inform you that in my spare time I am working on a project which will certainly interest you and may tangentially be pertinent to your proposal.

In a nutshell, the operation is the following:

Problem: Thermal and chemical pollution generated in the city as a consequence of energy use.

Philosophy: Remove the constraints that limit the full deployment of a system, by means of fixes of the "drawbridge engineering" type.

Solution: The solution stems from the elementary observation that what is used in a fuel is not energy (it is always finally thrown away under the nickname of waste heat) but negentropy, which is destroyed and leaves no junk around. The negentropy in fuels comes from their ability to burn, i.e. release heat, at temperatures substantially higher than room temperature.

Now the question comes if negentropy can be carried "dissociated" from energy and heat, and the answer is yes. A compressed gas is a practically pure carrier of negentropy. When expanding, e.g. isothermally, it produces work and absorbs from the ambient and amount of heat exactly equivalent to the work produced. When the work in question will finally be degraded to heat, the balance of the system will nicely turn to zero again. The work has been done, no trace has been left.

Simple calculations show that the amount of negentropy carried by a compressed gas, is somehow too low to engineer it into a palatable concoction.

The next best candidate I found is liquid air. A liquefied gas is in many ways similar to a compressed gas. It can be transformed into it, just by heating it into a closed vessel. The negentropy of liquid air is equivalent to about .2KWh/liter, and it is sufficiently high to design a system of reasonable proportions.

Implementation: Liquid air is generated at an energy center located where the waste heat produced from the operation can be disposed of (e.g. in the sea). It is then piped to the city. Production and piping make recourse to existing technology.

The city is divided into sectors, e.g. 500x500m, each sector receiving the energy in various forms from an integrated energy center. (The concept of total energy centers is operational in many places, and provides mainly electricity and hot water.)

Each energy center produces electricity, hot water, cooling fluids and air conditioning in a partially closed curcuit.

These fluids and electricity are generated by, in a sense, running an air liquefaction plant in reverse, and producing mechanical energy to produce electricity, in order to run heat pumps, and to provide cool sinks to thermodynamic cycles of more complex character.

The volume of liquid air necessary, per man, with a hustle and bustle on the Manhattan scale, can be estimated in around $0.5m^3$/day grossly equivalent to the volume of water he consumes. The water system thus gives the scale of the operation. Cars (with compressed air engines) would run on liquid air (a tankful may last for the day).

Chemical Pollution: The final produce of the operation would be very pure air.

State-of-the-art: All the components for the operation can be bought off the shelf. For the system to be economically plausible, however, their efficiency (thermodynamical) should be increased by about 50% to something around 75%. From contacts with people in the business of LAIR machinery and components, this target might be achievable soon by applying the most advanced designs (essentially for compressors and turbines) from the aeroindustry.

Resilience: The resiliency of the system can be realized by:

(a) interconnecting the fluids distribution system (each station may serve 1/2 of the load of its sector, and 1/8 that of the neighboring ones.

(b) storing LAIR on the spot. Modern techniques rely on the "hole in the ground" concept, successfully utilized for storing LNG. I have estimated that one week up to one month reserves may be stored locally.

Further development: A good idea must have an evolutionary potential. In this case this potential relies on the development of machinery to use the thermal gradients of the ocean. Research in this field is going on actively in U.S. under the auspices of NSF and with the work of Universities and engineering companies (Bechtel, Lockheed).

They simply run a steam engine (NH_3!) between 25°C and 7°C, apparently with promising economics. This engine produces obviously mechanical energy and the question is what to do with it. One of the proposals is to make electricity to be transformed into hydrogen and then ammonia. In this case, energy would be extracted from the ocean (which would be left slightly cooler than before, and somehow mixed up) to be then released at the consumption point.

My suggestion would be to make liquid air directly, using the mechanical energy in a LAIR plant.

LAIR would then be shipped in tankers, similar to those used for transporting Liquid Natural Gas, and finally delivered to the system as described above.

In this case, no energy would be extracted from the ocean (it would still be mixed up. What we are recuperating in fact is the negentropy of mixing). The mechanical energy from the ocean gradient plant would be released again into the cooling water of the LAIR plant.

The system would then be athermic all the way round. And the concept of energy, dissociated from that of heat.

Reactions?