Fuel for thought

Energy and the environment go together like tea and toast or peaches and cream. The difference is that with the food pairings it is possible to have one without the other.

But our needs for energy (normally meaning burning fuel of some sort), and the subsequent effect on our environment (particularly air quality both indoors and outdoors), are much more closely intertwined. They are like two dancers caught up in an eternal waltz.

Humans first exploited the properties of fire as a heating, cooking and lighting source one million or more years ago. At a later point, the campfire was brought inside their caves and self- build huts where the accepted arrangement became a central fire built under a roof opening to allow the choking smoke to escape. A variety of approaches over subsequent centuries were tried to improve the draught of the fire. However, even the best open fire that could be made was only around 20% efficient because most of the heat escaped through the ventilation hole in the roof, necessary to prevent suffocation of the inhabitants. The Ancient Romans took other, cleaner, approaches, using underfloor heating systems in their villas, and used solar radiation to warm their bath-houses through south-facing windows. Elsewhere by the 800s stone fireplaces with a short flue to the outside for more efficient smoke removal appeared, followed by metal stoves in the 17th century using primarily wood or coal as fuel. By the late 18th century in Ireland, peat was the dominant fuel. It soon became plain that coal generated large amounts of materials which blackened rooms and could attack furnishings; the culprits were, and still are, soot and sulfur dioxide, which have adverse health consequences as well. The French unknowingly got around the problem with the invention of a so-called 'smokeless stove', in the late 1600s. It was one of the first environmentally-friendly advances made by us because it co-located the fresh fuel with the combustion effluent and, by so doing, directed all combustion products over the fuel that was already burning. This arrangement ensured complete combustion and much cleaner indoor air resulted. The use of oil and bottled or natural gas as heating fuels is a much more recent innovation because they are not as simple to burn in the house as throwing a log onto a fire.

And that is the heart of the indoor and outdoor air quality problems we face because our mind-sets have been conditioned by the past to favour the burning of solid fuels over liquids and gases.

Who cares? We have known for many years that carcinogenic chemicals and much smaller particulate matter (PM) than soot are produced by the combustion of fossil fuels. The small solids, termed PM2.5, (that is a particle 2.5 microns in size), are invisible to the naked eye but can kill with long-term exposure. PM is a complex mixture of extremely small particles and liquid droplets that is made up of a number of chemical components including acids (like sulfuric and nitric), organic compounds (some carcinogenic), elemental carbon (soot) and metals (like lead). So you can see the materials involved are mainly quite toxic. Size matters too as the particles can become deposited into the larger (tracheobronchial) branches of our lungs where the effects on at-risk people (children, pregnant mothers, asthmatics and those suffering from cardiovascular problems), can be severe, especially over long exposure times.

In response to this problem WHO (World Health Organization) have recently published two new sets of guidelines. The first is on indoor air quality related to household fuel combustion and the second on lower limiting values for PM2.5 exposure, which are considerably below those operating currently in the EU. They focus on the inefficient burning of solid fuels in households as being an important contributor to the 482,000 deaths counted in the European Region during 2012 directly related to air pollution.

On its own initiative Ireland has introduced a 'smoky (bituminous) coal' ban in many cities and towns and as a result of consultations with the public, a North- South Study was set up in 2012 to provide advice on the burning of solid fuel in Ireland and its environmental consequences. This report is likely to recommend a total ban throughout the island of Ireland, in part, because of smoky coal's high PM2.5 emission levels (4.3 kg/1000 kg burnt) compared to home heating oil (0.1 kg/1000 kg burnt) and gas (0.0/1000 kg burnt). The levels are even higher for peat (4.5 kg/1000 kg burnt) and (9.0 kg/1000 kg burnt) wood. Note that the second figure is twice as high as that measured for smoky coal. However, wood does have one advantage: it's the closest to being carbon neutral.

What to do? Try to avoid using an open fireplace. Whilst the burning of any form of carbon-based fossil fuel will lead to global warming by producing carbon dioxide, if you do have to then use a gas over a liquid over a solid. If you are building a new house or upgrading an existing one, from a health and environmental perspective we should learn from the Ancient Romans and the French: (i) Use radiant panels powered by solar energy. Advances in technology are continually bringing the cost of these down. (ii) Burn the most sustainable fuel (that is dried wood), but do so only in a modern, closed, very high-temperature combustion stove coupled with a heat-recovery-ventilation system. And plant a few trees in your new garden to take up the carbon dioxide that you release by burning fossil fuels!

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