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Determination of Protecting Public Health

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While the majority of air pollution management techniques try to reduce emissions, efforts are also being made to change the transport of air pollutants, exposure to pollutants, and the health response. The location of polluting plants, how the terrain lays and the wind blow in an area, and the height and design of pollution stacks all have an impact on the transmission of air pollutants. Tall smokestacks, a pioneering strategy to reducing local air pollution, operate to distribute pollutants across broader regions [1]–[3]. Reducing human exposure to pollutants may also help to mitigate the negative health impacts of air pollution. The deployment of an ozone warning day is an example of this latter strategy: when harmful ozone levels are expected, the public is warned so that vulnerable persons for example, children, persons with asthma, and the elderly may reduce their exposure by remaining inside. Lastly, the health effects of air pollution may be influenced by peoples access to and quality of health-care systems, accessible treatment choices, and inter-agency communication. For example, if an industrial release of air pollutants occurs, a physician may be able to treat patients more efficiently if he or she is aware of the dangerous pollutant involved.

Regional Air Pollution and Other Environmental Problems

Several atmospheric contaminants have numerous effects on air quality and human health. NO2, for example, has a direct impact on health but also contributes to the production of ozone, while SO2 contributes to the development of particulate matter. Several other environmental issues are exacerbated by ambient air pollution. The principal sources of acid precipitation are NOx and SOx. Interior air pollution levels are connected to both indoor sources and outside air penetration. PM and ozone have an impact on visibility. The same fossil fuel combustion processes that emit pollutants into the atmosphere also emit greenhouse pollutants like carbon dioxide CO2 and methane CH4, which contribute to global climate change. Numerous technologies and strategies to decrease ambient air pollution might also reduce greenhouse gas emissions, and vice versa Hence, controlling regional air pollution and its associated health impacts is inextricably linked to ecological health and climate change.

Energy Production

Most human activities, from cooking and heating in the home to transportation and economic activity, need energy. Innumerable ways, energy consumption enhances health and well-being. People and products may travel more easily when petroleum is utilised for land, sea, and air transportation. Heating, cooling, and cooking in the home, whether powered by electricity, gas, or biomass, protect people from the health dangers associated to hot and cold weather, as well as foodborne and waterborne infections. Electricity is required for public health services such as water purification and hospitalisation. Energy utilised in industrial production may provide employment and raise family income, which can lead to better health. Moreover, energy usage is inextricably tied to global economic growth in a two-way relationship: energy helps enhance productivity and improve living standards, while better living standards contribute to increased energy demand. Yet, energy creation and consumption may endanger public health. Coal mining endangers miners, and coal combustion emits pollutants into the atmosphere. Dams used to generate hydroelectric electricity may disrupt local ecology, increasing the risk of waterborne infections.

Nuclear energy facilities provide the possibility of catastrophic releases, as shown by the accidents at the Three Mile Island and Chernobyl nuclear reactors, as well as long-term threats from radioactive waste. Since these health risks often manifest as environmental exposures, the health consequences of energy usage are primarily an environmental health problem [2], [4]. Obviously, energy decisions may have both beneficial and bad health consequences. People, governments, and commercial companies frequently make choices about their energy consumption, including how much to use, what kind to use, and how to get it. These judgements are often based on cost and availability, and decision makers frequently disregard the far-reaching public health implications of their decisions. This chapter examines the global patterns of energy consumption, including the sources, quantities, and uses of energy. It also discusses the health effects of different types of energy. Finally, the chapter examines some of the main issues that people and countries confront when making energy decisions, with a focus on public health implications.

Patterns of Human Energy Use

Global energy use varies greatly. There are two broad patterns that stand out. Secondly, individuals in affluent countries use far more energy per capita than those in poorer countries. Second, the sources of energy differ according to socioeconomic status. Per capita energy usage in industrialised nations defined in this chapter as members of the Organization for Economic Cooperation and Development is around 4,600 kilogrammes of oil equivalent per year, compared to 828 kgoe/year in underdeveloped countries The disparity is even more pronounced when we compare the United States, which uses 7,921 kgoe/year, to Sub-Saharan African nations like Tanzania, which uses just 391 kgoe/year. Although accounting for just 22% of the global population, industrialized nations utilise 61% of the energy consumed yearly World Resources Institute.

In each area, industry contributes for 25 to 40% of total energy consumption. Transportation consumes a significant amount of energy in places with lower population concentrations, such as North America and Oceania. Residential usage makes for a higher share of overall energy consumption in emerging countries, despite lower per capita residential use. Energy consumption is predicted to rise dramatically in the future decades. According to the International Energy Agency IEA, world primary energy consumption would rise by 1.7 percent each year between 2000 and 2030, reaching 15.3 million tonne equivalents of oil. This is somewhat slower than the pace seen between 1970 and 2000. Energy consumption is predicted to expand at the fastest pace in low- and middle-income nations, rising from 30% of global energy demand in 2000 to 43% in 2030.

Household Energy Demand and Electricity in Developing Countries

Income level has a strong influence on household energy demand and fuel choice IEA, 2002. The poorest families often can only afford traditional biomass fuels for basic needs. Heating and cooking are two examples of such need. Energy consumption rises as family income rises. and the sources of energy shift. Household appliances are powered by electricity. Personal automobiles are powered by petroleum products. Moreover, kerosene and propane Cooking and heating sources are often becoming more popular. When income grows, Moreover, energy consumption rises to power air conditioners, computers, and other electronic devices. and other appliances. Heating and cooking in the home grow increasingly reliant on Natural gas and electricity.

Improving household electrical access is seen as a crucial component of It is also critical for decreasing the environmental and health consequences connected with harvesting and utilising biomass fuels. Around 1.6 billion people People lack access to power. The vast majority reside in developing-country rural regions. nations, notably Sub-Saharan Africa 509 million and South Asia 801 million IEA, 2002. As the population grows particularly in metropolitan areas, the number of The number of individuals without access is projected to fall modestly if governments follow through on their promises. can supply dependable electrical supplies to rapidly developing metropolitan regions. Availability to electricity has grown significantly during the last 3 decades, with electrification rates rising from 25% of developing-country homes in 1970 to 75% now. compared to 64% in 2000 IEA, 2002. Notwithstanding the fact that electrification is a vital step for There is hardly a certainty that families will switch to greener energy sources. will alter. Between 1980 and 2000, China attained 98 percent access to energy. of its population, giving over 700 million people access IEA, 2002. However Due to cost and habit, many Chinese families continue to depend on locally accessible coal for cooking and heating [5]–[7].

Energy Sources and Associated Health Risks

While the quantity and kinds of energy utilised across the world vary greatly, people and governments face certain similar concerns. With the resources at their disposal, how can they effectively offer the energy services required to fulfil daily family requirements and economic productivity while also controlling the negative health and environmental consequences? It is useful to consider the entire fuel cycle for each source of energy: fuel extraction or collection, processing or refinement, direct use for energy as in gasoline combustion in an automobile engine or coal combustion in steel manufacturing or transformation into another energy form as in electricity generation, and waste disposal. There are upstream and downstream health and the environment repercussions throughout the fuel cycle, which are typically far away from the point where the energy services are utilised. To address household and national energy demands, a variety of fuels are employed. The sun provides the majority of the energy accessible for human use, either directly as solar energy or far more often indirectly. Oil, natural gas, and coal were produced over millions of years from vegetation that absorbed sun energy via photosynthesis. Wood, peat, and agricultural leftovers are also formed from plants that absorb solar energy, but biomass fuels develop on a human timeframe rather than a geological one and are therefore considered renewable. Wind, hydro, wave, and tidal energy are all derived from the movement of air and water caused by solar energy.

Geothermal energy uses the heat inside the earths crust, while nuclear energy uses the energy within uranium atoms. The use of fossil fuels is predicted to expand further IEA, 2002. Rising demand for power is expected to result in considerable increases in coal and natural gas consumption, while increased personal car ownership will continue to raise demand for petroleum. Since petroleum, petrol, and coal are used at a far quicker pace than they are regenerated, their usage is potentially limited. In reality, using the Hubbert peak a way of estimating when petroleum production will peak and then decline suggests that worldwide demand will surpass supply early in the twenty-first century, and the supply-demand gap will continue to grow forever. Coal, on the other hand, looks to be abundant for at least decades, if not longer, despite rising global demand. Coal is directly employed in electric power generation as well as heavy industrial processes such as steel and cement manufacture. It contributes for 48% of power production in the United States and Canada, 78% in China, and 39% worldwide IEA, 2002. In areas where it is locally accessible, such as China, it is also utilised for domestic heating and cooking.

Using coal as an energy source has environmental and health consequences throughout the fuel cycle. Underground coal resources are mined either underground or open-pit. Miners in the former utilise tunnels to collect coal from under the surrounding layer. To get access to the coal, the layer above it is totally removed in the latter case. Coal mining may pose serious environmental and health dangers to miners and populations nearby. Coal miners are exposed to airborne coal dust, which may cause pneumoconiosis, often known as black lung disease, and raise the chance of acquiring other diseases such as TB. They are also at danger of being injured as a result of cave-ins and explosions. Coal mining may pollute neighboring aquatic systems significantly, especially when large volumes of overlaying material and debris are discharged into local streams throughout open-pit mining. This dumping discharges coal pollutants such as sulphur and heavy metals into rivers, altering aquatic ecosystems and possibly poisoning drinking water sources [6], [7].

Growing Energy Demand

With over one billion people and one of the worlds fastest expanding economies, Chinas energy predicament underlines the global environmental and health issues. With around 20% of the worlds population, China accounts for 28% of worldwide coal consumption and contributes 14% of anthropogenic CO_2 emissions IEA, 2002 [8], [9]. In order to be utilised, petroleum must be refined into petroleum products. This process leads in the production of carcinogenic molecules, such as benzene, that can damage employees and adjacent populations. Immediate health impacts related with the burning of petroleum arise from the production of particulate matter, carbon monoxide, carbon dioxide, nitrogen and sulfur oxides, and polycyclic aromatic hydrocarbons. Automobile emissions of particles and ozone-forming nitrogen oxides are a prominent source of air pollution in big metropolitan centres and along major truck traffic routes.

In several nations lead is added to gasoline as an octane enhancer to improve the efficiency of the gasoline combustion in motor vehicles. As the leaded gasoline is burnt, lead is discharged into the air as part of the vehicle exhaust. Once in the air, lead may be directly absorbed or consumed as dust that accumulates in hightraffic areas. Even modest levels of prenatal and early childhood lead exposures are associated with developmental and neurological consequences. Removing lead from gasoline has been a successful technique for lowering infant lead poisoning in the United States and other affluent nations. Natural gas was formed together with other fossils fuels during the transformation of ancient biological material. It is used for power generation 35 percent of total worldwide consumption as well as to address industrial and household energy needs IEA, 2002. IEA, 2002. The usage of natural gas is likely to continue to climb as a proportion of total energy consumption as new sources are located and brought into production and as the network for transporting natural gas is enhanced.

Natural gas burns cleaner and produces more energy than other fossil fuels. Upstream health impacts include the danger of fire and explosion during the exploration, drilling, and delivery processes. The downstream effects are comparable to those of other fossil fuels, but frequently less severe. Natural gas, in particular, emits far less sulphur oxides, oxides of nitrogen, and heavy metals than coal or oil burning. Minimizing the Environmental Effects of Fossil Fuels. There are many actions that may be done to decrease the environmental and health impacts of fossil fuel consumption. Upstream impacts may be mitigated by improving extraction and processing technology, as well as establishing and enforcing worker safety and health laws.

A combination of steps, such as switching to cleaner fossil fuels or renewables, may lessen the downstream impacts of particulates, CO, SOx, NOx, and other pollutants. Switching from coal to natural gas for power production, for example, may cut SO2 emissions. Similarly, in poor nations, moving from coal to liquefied petroleum gas for residential heating and cooking may minimise particle emissions. Utilizing a cleaner grade of a certain fuel source such as switching from low-sulfur to high-sulfur coal may have a comparable impact. Nevertheless, these measures are not always successful in lowering CO2 emissions. Technological advancements may also lower emissions and hazards. Possible technical developments include efficiency improvements, such as increased automotive fuel economy or more efficient power production. Those modifications imply that less fuel is needed to deliver a given energy output, and hence all associated health risks are lowered. Advances in emission control systems may lower the amounts of certain toxins emitted into the environment, but not CO2 levels. The short-term expense of transitioning to more costly fuels or new technology is the key impediment to many of these transitions. Reduce the amount of energy used for non-essential activities as a last technique for lowering the health impacts connected with fossil fuel consumption. Conservation provides economic efficiency as well as environmental and health advantages.

Biomass

Wood, peat, agricultural remnants such as maize husks and coconut shells, and animal manure are examples of flammable organic materials created by plants over a period of months to years which derives from nondigestible plant components in the animal diet. While biomass fuel has existed for thousands of years and is a traditional energy source in many cultures, there is increased interest in biomass as an ecologically sound, renewable source of energy, employing crops such as alfalfa, grasses, maize, and fast-growing trees. Biomass may be burnt directly or transformed into other combustible compounds, such as ethanol or methanol, or even gasified, in contemporary technologies. In truth, the conversion of biomass into more manageable forms is not new; for ages, wood has been transformed to charcoal by oxygen-poor burning.

According to estimates, 2.4 billion people depend on burning forest products, agricultural waste, or animal dung as their principal source of domestic energy IEA, 2002. Biomass fuels are especially significant in Sub-Saharan Africa and South Asia, where they account for more than 90% and 80% of household energy consumption, respectively IEA, 2002. Biomass fuels are generally derived from agricultural wastes, animal manure, and harvested fuelwood in rural regions. In cities, charcoal, which is lighter and more efficient, is often used. In certain developing and developed nations where such fuels are easily accessible, biomass fuels are also employed in industrial processes. In poor nations, biomass will continue to be a major source of domestic energy IEA, 2002. Even in nations where accessibility to electricity has been considerably increased in both urban and rural areas, traditional fuels remain an essential and sometimes preferred energy source.

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Traditional biomass fuel combustion for domestic energy requirements is a significant source of indoor air pollution in poor nations WHO, 1992. Incomplete combustion releases particles and CO, as well as CO2 and other pollutants. Fuels are often used in open flames or poorly ventilated stoves, enabling toxins to accumulate in the residence. As a consequence, particle and CO concentrations in households with open combustion of biomass fuels may be substantially greater than in extremely polluted cities. The greatest levels of exposure occur in these families among women, who spend more time than males near the fire and cooking, newborns strapped to their mothers backs, and young children who might just spend time inside. Chronic obstructive pulmonary disease, acute respiratory infections, low birthweight, infant and perinatal mortality, pulmonary tuberculosis, cancer, and cataracts are all linked to indoor air pollution from biomass use. In addition to the risks connected with indoor air pollution, the use of biomass fuel particularly in open stoves or fires provides an injury risk to children and anyone who work or play near these flames.

Biomass fuel provides the potential of a low-cost, renewable, and environmentally friendly fuel, and much effort is being put into developing novel biomass sources. There are many ways available for decreasing the health risks linked with the usage of biomass fuel. Some of the environmental and health effects of fuelwood gathering may be mitigated by good community forest management and woodlots built and maintained to produce wood in a sustainable manner. These methods may minimise collecting time and energy requirements, as well as the environmental harm caused by overharvesting. The promotion of better cookstoves is one strategy to decreasing the health impacts of indoor air pollution. Two characteristics are shared by all of the designs. First, they restrict and enclose the fire, resulting in more efficient combustion that minimises particle emissions and the overall quantity of fuel consumed. Second, the smoke from the fire is ventilated outside the house to prevent it from settling within. While improved stoves may significantly cut emissions, initial costs and cultural preferences for conventional cooking methods have hindered their use in certain areas.

Hydroelectric

Hydroelectric power is created when falling water flows through turbines, turning them and creating energy. The power produced by small and major dams accounts for just 17% of total worldwide electricity output IEA, 2002. Yet, in countries such as South America, where water resources are plentiful and other commodities such as coal are scarce, hydroelectric energy is a more cost-effective option. Hydroelectric power accounts for 68 percent of total regional energy supply in South America IEA, 2002. In China, where the famed Three Gorges Dam has boosted the countrys share of hydroelectric power, hydroelectric electricity is also a cost-effective option. Hydroelectric power has several benefits. It produces no combustion products and does not contribute to climate change but reservoirs may release greenhouse gases. While dam building has substantial initial capital expenses, energy generation costs relatively little after that. Yet, public knowledge about the environmental and socioeconomic implications of massive dam developments has grown in recent decades Rosenberg and others, 1997. These costs include population relocation and cultural artefact loss in flooded regions stream of the dams, diminished fish harvests downstream, significant alteration of local ecosystems, and, in many instances, increased human health hazards. In several dam projects, infectious illnesses such as malaria, Rift Valley fever, and giardiasis have grown as a result of dam development.

Nuclear

Uranium is used as a fuel in nuclear fission. The uranium atoms are divided, and a controlled chain reaction occurs, producing heat and radioactive material. The heat is used to make steam, which spins turbines, which provide electricity. Nuclear energy accounts for around 17% of worldwide power production, with the vast majority 86% happening in OECD nations. Its manufacturing capability is concentrated in nations with more tolerant regulatory environments. France, for example, is a proponent of nuclear power. According to the International Energy Agency, nuclear power output in wealthy nations would fall over the next three decades while increasing by 300 percent in developing ones. Many characteristics make nuclear power an appealing option for emerging nations attempting to fulfil rising household and industrial energy demand. Nuclear power generation, unlike fossil fuel power generation, does not emit CO_2 or contribute to climate change. It also has no effect on local or regional air pollution, unlike coal-fired energy. Its usage is less economically reliant on regular imports of raw materials that may not be locally accessible.

But, growth is hampered by the lack of local technology and public concern about health dangers. The principal health concerns linked with nuclear power are related with the disposal of radioactive waste material and the likelihood of radioactive emissions as a consequence of accidents, such as the one at Chernobyl. The nuclear fission process creates plutonium as well as lighter elements such as strontium-90 and cesium-137 by breaking uranium-235 atoms. These by-products are considered high-level waste because they may cause a range of health consequences or death in people see Chapter Twenty-Four. The lighter elements emit more harmful, penetrating radiation but have a shorter half-life about 35 years, while plutonium has a substantially longer half-life around 24,000 years. These waste products provide substantial issues because they must be transported to and kept in specially specialised waste facilities for extended periods of time. In affluent nations, public resistance to these plants is a substantial impediment to nuclear power. Nuclear waste dangers may be exacerbated in underdeveloped nations if the government lacks the regulatory and enforcement capabilities to guarantee that such material is transported and stored securely.

The Chernobyl nuclear reactor tragedy, which occurred near Kiev, revealed the serious health dangers linked with insufficient security and functional controls in nuclear power plants. During a cleaning procedure in April 1986, an uncontrolled reaction occurred, culminating in an explosion and fire in one of the facilitys four reactors. Almost 30 individuals were killed in the original explosion, which forced the evacuation of nearly 100,000 people. Iodine-131 was discharged into the environment as a result of the explosion and fire. Later research found a considerable rise in juvenile thyroid malignancies, as well as an increase in cancer-related mortality, leukaemia, other thyroid illness, and psychological consequences United Nations Scientific Committee on the Effects of Atomic Radiation, 2000. While nuclear power will continue to be an appealing alternative for developing nations with expanding energy demands, the storage and transport of radioactive materials, as well as the possibility of accidental release, constitute a considerable public health risk.

New Renewable Energy Sources

Many new renewable energy technologies have been created and refined during the last three decades to the point that there now economically feasible, at least in certain contexts. These include methods for generating solar, wind, and geothermal energy. Others, like as those employing fuel cells and hydrogen, may become increasingly essential in the future decades. These sources are presently combined. account for less than 1% of global power output and are expected grow more than tenfold to account for 3% of production by 2030. They will remain significant in locations where natural factors make them more cost effective high, continuous winds or strong solar radiation, as well as in off-grid applications. These new renewable energy sources provide much lower health concerns than the fossil fuel ones they are expected to replace. Yet, there are some significant dangers and negative externalities to consider. Large wide regions with strong, continuous winds are required for commercial wind energy generation. Windmills concentrated in a single area may have a visual and aural influence on surrounding inhabitants, threatening their well-being or quality of life. The production of photovoltaic cells for use in solar energy operations generates trace amounts of hazardous chemicals. They may constitute a health concern to employees and local populations if not properly handled and disposed of. Possibilities for risk management include developing less hazardous replacements for the chemicals involved, lowering chemical concentrations or amounts utilised, and enhancing waste management.

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