Hypothesize and outline two different methods for reaching Factor 4 and Factor 10 reductions in resource use for the construction industry. Include your assessment of how these reductions might affect both building codes and land use policies in the United States.

Industrial economies depend on natural resources to fulfill fundamental societal needs and also to facilitate desirable improvements in living standards. However, unrestrained exploitation of materials and energy resources has led to unacceptable levels of pollution and unsustainable pressures on the earth’s ecological integrity. It is clear that we need to begin to balance our requirement for natural resources with a need to protect the environment and to conserve non-renewable resources for future generations.

Environmentally benign construction that meets the demands of the users and considers economics starts with the design of buildings, components, and individual products. Construction flows in US constitute more than a quarter of total material requirements. The extraction of construction minerals such as sand and gravel imposes pressure on the local environment through the destruction and long-term change of natural habitats and distortions of the potable water supply. Bringezu states in his study that quarries and the earth movement associated with the build up of infrastructure significantly contribute to changes in landscape. He continues that in the form of buildings and infrastructure, the minerals, which are used in construction, affect a larger area than the physical area associated with natural deposits. This increase in the built-up area is associated with a loss of natural, reproductive, and ecological buffering land.

In the US, construction aggregates are an important and large input to the economy. Urbanization has generated a high demand and also increased quantities of construction debris
that may provide an additional source for aggregates. The supply of construction debris is regional, and is determined by local infrastructure decay and replacement rates. Aggregate recycling rates are greatest in urban areas where replacement of infrastructure is occurring, natural aggregate resources are limited, disposal costs are high, or strict environmental regulations prevent disposal.

Leading organizations such as the Wuppertal Institute and the Factor 10 Club and a growing number of individuals such as Ernst von Weizsacker, Paul Hawken and Amory Lovins have been calling for a huge increase in resource productivity, by a factor of 4-10 in order to increase wealth for 4/5 of the world's population and to decrease environmental impact. Factor 4 means that resource productivity can and should grow fourfold; thus we can live twice as well while using half as much. A proposed goal for industrialized countries is to increase the resource efficiency by a factor of 4 to 10 over the next thirty to fifty years. This increase in resource productivity guarantees that economic performance and welfare can be increased while the absolute burden to the environment as a consequence of resource extraction is reduced. This is critical because the industrialized economy is incredibly wasteful in use of resources while the planet has a finite amount of resources and a finite ability to absorb and process wastes. For example, only 3 percent of the energy produced by a nuclear or coal-fired power plant to power an incandescent light bulb actually results in light. The factor 4-10 concept is also intended to reduce the disparity between nations and regions in terms of sharing the use of resources and the burden to the global and regional environment. Industrialized countries are being challenged to reduce their resource requirements while meeting the demands of their citizens, guaranteeing them adequate material welfare.

There can be several strategies or methods implemented to reach the goals of factor 4-10 and to sustain the physical basis of societies. The main strategies may be rematerialization and dematerialization. Those strategies leads to a construction industry that the requirements for its
primary resource inputs and final disposal would be reduced while the volume of flows within the anthroposphere would not be diminished.

The process of dematerialization provides time and energy efficiency through the construction process. It aims at the absolute reduction of the material flows in anthroposphere. The ordered issues of dematerialization can be listed as:

- Efficient production
- Service delivery
- Efficient consumption and increased sufficiency
- Efficient waste management

Rematerialization also should occur through the process of dematerialization. The ordered issues of rematerialization are:

- Reuse
- Remanufacturing
- Recycling

Bringezu explains the relation between those two strategies; rematerialization, dematerialization briefly in his study. He states that a steady-state situation between inputs and outputs may only be reached by reducing the inputs to construction. Thus, the successful implementation of a rematerialization strategy increases the need for resource efficiency and effective dematerialization. There are several parameters that have a major influence on the material and energy intensity of construction such as: type of construction, materials chosen, durability, repairability, and dismantlability. An example given by Bringezu is a good one to see the connection of these parameters with the Factor 4-10 reductions. He believes that, if the mass of a new construction could be reduced by one-third, if the choice of materials could reduce the material requirement, again by one-third, if the durability was, on average, extended by one-third
and if the repairability and dismantlability contributed the same one-third factor, then the overall effect would be a factor of 5 reduction in resources.

Material flows for energy supply also constitutes a major part of societal metabolism. Thus, planning for energy supply for construction industry is crucial. The demand for electric and thermal energy of the planned construction, the possibilities of reducing requirements for non-renewable energy, and the selection of alternatives with the lowest resource requirements on a life cycle wide basis, should be determined.

A change of product management may significantly contribute to changing a distorted incentive structure that avoids resource efficiency and dematerialization. In addition, architectural fees should be based on avoided costs for energy and materials instead of the volume or weight of the buildings. In the end, construction standards will have to minimize the use of materials while guaranteeing safety conditions. Depreciation rates should be revisited in order to consider the real condition of materials stocks and to provide an incentive for a prolonged use of buildings and infrastructure.