

Directions: In this section, you are going to read a passage with ten statements attached to it. Each statement contains information given in one of the paragraphs. Identify the paragraph from which the information is derived. You may choose a paragraph more than once. Each paragraph is marked with a letter. Answer the questions by marking the corresponding letter on **Answer Sheet 2**.

The Impossibility of Rapid Energy Transitions

- A) Politicians are fond of promising rapid energy transitions. Whether it is a transition from imported to domestic oil or from coal-powered electricity production to natural-gas power plants, politicians love to talk big. Unfortunately for them (and often the taxpayers), our energy systems are a bit like an aircraft carrier: they are unbelievably expensive, they are built to last for a very long time, they have a huge amount of inertia (meaning it takes a lot of energy to set them moving), and they have a lot of momentum once they are set in motion. No matter how hard you try, you can't turn something that large on a dime(10美分硬币), or even a few thousand dimes.
- B) In physics, moving objects have two characteristics relevant to understanding the dynamics of energy systems: inertia and momentum. Inertia is the resistance of objects to efforts to change their state of motion. If you try to push a boulder(大圆石), it pushes you back. Once you have started the boulder rolling, it develops momentum, which is defined by its mass and velocity. Momentum is said to be "conserved," that is, once you build it up, it has to go somewhere. So a heavy object, like a football player moving at a high speed, has a lot of momentum—that is, once he is moving, it is hard to change his state of motion. If you want to change his course, you have only a few choices: you can stop him, transferring (possibly painfully) some of his kinetic energy(动能) to your own body, or you can approach alongside and slowly apply pressure to gradually alter his course.
- C) But there are other kinds of momentum as well. After all, we don't speak only of objects or people as having momentum; we speak of entire systems having momentum. Whether it's a sports team or a presidential campaign, everybody relishes having the big momentum, because it makes them harder to stop or change direction.
- D) One kind of momentum is technological momentum. When a technology is deployed, its impacts reach far beyond itself. Consider the incandescent(白炽灯的) bulb, an object currently hated by many environmentalists and energy-efficiency advocates. The incandescent light bulb, invented by Thomas Edison, which came to be the symbol of inspiration, has been developed into hundreds, if not thousands, of forms. Today, a visit to a lighting store reveals a stunning array of choices. There are standard-shaped bulbs, flame-shaped bulbs, colored globe-shaped bulbs, and more. It is quite easy, with all that choice, to change a light bulb.
- E) But the momentum of incandescent lighting does not stop there. All of those specialized bulbs led to the building of specialized light fixtures, from the desk lamp you study by, to the ugly but beloved hand-painted Chinese lamp you inherited from your grandmother, to the ceiling fixture in your closet, to the light in your oven or refrigerator, and to the light that the dentist points at you. It is easy to change a light bulb, sure, but it is harder to change the bulb and its fixture.
- F) And there is more to the story, because not only are the devices that house incandescent bulbs shaped to their underlying characteristics, but rooms and entire buildings have been designed in accordance with how incandescent lighting reflects off walls and windows.

- G) As lighting expert Howard Brandston points out, "Generally, there are no bad light sources, only bad applications." There are some very commendable characteristics of the CFL [compact fluorescent(荧光的) light bulb], yet the selection of any light source remains inseparable from the luminaire(照明装置) that houses it, along with the space in which both are installed, and lighting requirements that need to be satisfied. The lamp, the fixture, and the room, all three must work in concert and for the true benefits of end-users. If the CFL should be used for lighting a particular space, or an object within that space, the fixture must be designed to work with that lamp, and that fixture with the room. It is a symbiotic(共生的) relationship. A CFL cannot be simply installed in an incandescent fixture and then expected to produce a visual appearance that is more than washed out, foggy, and dim. The whole fixture must be replaced—light source and luminaire—and this is never an inexpensive proposition.
- H) And Brandston knows a thing or two about lighting, being the man who illuminated the Statue of Liberty.
- I) Another type of momentum we have to think about when planning for changes in our energy systems is labor-pool momentum. It is one thing to say that we are going to shift 30 percent of our electricity supply from, say, coal to nuclear power in 20 years. But it is another thing to have a supply of trained talent that could let you carry out this promise. That is because the engineers, designers, regulators, operators, and all of the other skilled people needed for the new energy industry are specialists who have to be trained first (or retrained, if they are the ones being laid off in some related industry), and education, like any other complicated endeavor, takes time. And not only do our prospective new energy workers have to be trained, they have to be trained in the right sequence. One needs the designers, and perhaps the regulators, before the builders and operators, and each group of workers in training has to know there is work waiting beyond graduation. In some cases, colleges and universities might have to change their training programs, adding another layer of difficulty.
- J) By far the biggest type of momentum that comes into play when it comes to changing our energy systems is economic momentum. The major components of our energy systems, such as fuel production, refining, electrical generation and distribution, are costly installations that have lengthy life spans. They have to operate for long periods of time before the costs of development have been recovered. When investors put up money to build, say, a nuclear power plant, they expect to earn that money back over the planned life of the plant, which is typically between 40 and 60 years. Some coal power plants in the United States have operated for more than 70 years! The oldest continuously operated commercial hydro-electric plant in the United States is on New York's Hudson River, and it went into commercial service in 1898.
- K) As Vaclav Smil points out, "All the forecasts, plans, and anticipations cited above have failed so miserably because their authors and promoters thought the transitions they hoped to implement would proceed unlike all previous energy transitions, and that their progress could be accelerated in an unprecedented manner."
- L) When you hear people speaking of making a rapid transition toward any type of energy, whether it is a switch from coal to nuclear power, or a switch from gasoline-powered cars to electric cars, or even a switch from an incandescent to a fluorescent light, understanding energy system inertia and momentum can help you decide whether their plans are feasible.
36. Not only moving objects and people but all systems have momentum.
37. Changing the current energy system requires the systematic training of professionals and skilled labor.
38. Changing a light bulb is easier than changing the fixture housing it.
39. Efforts to accelerate the current energy transitions didn't succeed as expected.

40. To change the light source is costly because you have to change the whole fixture.
41. Energy systems, like an aircraft carrier set in motion, have huge momentum.
42. The problem with lighting, if it arises, often doesn't lie in light sources but in their applications.
43. The biggest obstacle to energy transition is that the present energy system is too expensive to replace.
44. The application of a technology can impact areas beyond itself.
45. Physical characteristics of moving objects help explain the dynamics of energy systems.