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Modernizing the Physics Curriculum by Being Less Modern

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This presentation offers suggestions for changes that could be made to the undergraduate physics program to better prepare scientists and engineers for careers in energy, and in particular, renewable energy. The author's perspective comes from the traditional academic training at the undergraduate and PhD levels in physics followed by work experience in industrial research in solar energy. The traditional physics undergraduate curriculum is composed of Hamiltonian mechanics, quantum mechanics, statistical mechanics, and special relativity. In the laboratory, students typically repeat famous experiments in modern physics. While these subjects are essential to a comprehensive understanding of the physical world they do not provide the foundation necessary for work in energy production. The subjects at the core of energy production are classical thermodynamics, heat transfer, and fluid mechanics, yet they receive little if any attention in the physics curriculum. Most students of physics are familiar with the historic year 1905 but few know that one year earlier Prandtl revolutionized our understanding of fluid mechanics with his invention of the boundary layer which is at the heart of heat transfer. Reynolds and Nusselt are equally obscure. We will give examples of how the design of solar power plants requires solving elementary physical problems that are foreign to most physics students. Thermodynamic analysis, fluid mechanics, and heat transfer are core disciplines underlying the production of steam from which 90 per cent of the electricity in the US is derived. Knowledge of these subjects will continue to be essential for the future development of renewable energy. Unlike quantum mechanics, classical physics also helps to explain the phenomena of everyday life.