sis on *reception*, how readers respond to and reinterpret a text at different points in history—made a new encyclopedia overdue. A digital version will, the editors hope, make periodic updates possible. But they also see the printed volumes as important. "I think, particularly with canonical authors like Dante or Shakespeare or Virgil," Ziolkowski says, "people find great solace in the idea of sitting down and actually holding the whole text in their hands and engaging with it."

That text includes 2,200 entries written across nearly a decade by more than 350 scholars. Of the experts invited to take part, a surprising number responded with enthusiasm, "without trying to demur and wriggle out of it," Ziolkowski reports. "Many of them feel almost a sense of personal gratitude to Virgil for having opened doors to them as literary critics, for having led to events or travels, or encounters with other people that they value." The editors are no different. Growing up in New Zealand, Thomas had a childhood friend whose father and uncle were beekeepers, and the boys often watched them collect honey. When that friend died in college, Thomas found comfort in Virgil's verses about the "tiny and fragile world" of bees. Ziolkowski vividly remembers "the mixture of fear and pleasure" he felt as a teenager reading Virgil with a no-nonsense Latin teacher, and notes that his father, Theodore Ziolkowski, who wrote *Virgil and the Moderns*, shaped his own thinking about the poet.

The entries cover a vast array of subjects: Aeneas's doomed lover, Dido; Wilfred Owen, the British World War I poet who took cues from the *Aeneid;* the presence of Virgil in music. An entry by Michael Sullivan, Ph.D. '07, a classical philologist and research associate at Dumbarton Oaks, explores the debate about inscribing a verse from Virgil on the 9/11 monument, and the entries written by Thomas include one on the singer-songwriter Bob Dylan. The editors say there are topics to interest every reader; Ziolkowski compares the encyclopedia to "enabling people to walk down this wonderful corridor in a marvelous museum and to look through the doorways into rooms that are filled with beautiful paintings or objects. We can give them the excitement and the information they need," so that someday "they might want to come back to those rooms and spend more time." ~ERIN O'DONNELL

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A TAXING LIABILITY

The Fix in Fossil Fuels

THE UNITED STATES is wasting more than $4 billion a year by giving oil and gas companies tax breaks that do not benefit consumers or the economy, says Joseph Aldy, assistant professor of public policy at the Kennedy School of Government and a former special assistant to the president for energy and environment. This special treatment for the fossil-fuel industry, he points out, adds to the national debt and maintains the country's dependence on a finite natural resource that produces greenhouse gases.

Some of the tax benefits now in force date back nearly a century, to a time, he notes, when oil drilling was considered a "very risky economic activity" that deserved federal support. But improved drilling technologies and the global nature of the ever-growing market for liquid fuels have radically changed that original calculus, Aldy writes in a paper funded by the Hamilton Project, a Brookings Institution initiative that sponsors policy proposals intended to "create a growing economy that benefits more Americans."

Eliminating the tax breaks could slash the U.S. deficit by as much $41 billion in the next decade, Aldy asserts—without materially increasing retail fuel prices, reducing employment, or weakening the nation's energy security. "The vast majority of the provisions in the tax code that I call for eliminating effectively lower the cost of investing in a new oil field, gas field, or coal mine," Aldy says; thus, they make such investments more appealing than investment in a new factory, for example. This, he says, distorts how people make investment decisions, resulting in more capital and taxpayer monies going into oil and gas production. These tax breaks do not, however, have a material impact on U.S. energy production. (He cites a 2009 study, done for the nonprofit organization Resources for the Future, that indicates

First discovered in the 1880s, the Midway-Sunset oil field near Taft, California, remains in production today.

Photograph by Alan Tobey/Getty Images

removal of these tax breaks would reduce U.S. oil production by about 26,000 barrels per day, or less than one-third of 1 percent of current U.S. production.) In contrast, he points out, some now-expired tax provisions, such as the "unconventional gas tax credit," did provide incentive for firms to test novel technologies on a commercial scale and helped promote the development of shale gas fracking.

Although Aldy would eliminate 12 specific tax provisions that benefit oil and gas companies doing business in the United States, he writes that eliminating just three provisions in particular—expensing intangible drilling costs, the section 199 domestic-manufacturing tax deduction for oil and gas, and percentage depletion for oil and gas wells—would yield 89 percent of the potential economic benefits that his study projects. That would not only level the playing field between fossil- and alternative-fuel companies, but also enable the U.S. government to make the case that large developing countries like India and China might also benefit by phasing out their fossil-fuel consumption subsidies. At the 2009 G-20 summit in Pittsburgh, he notes, world leaders recognized that fossil fuels were being subsidized globally to an extreme extent (about half a trillion dollars) and called for the practice to end. Eliminating consumption subsidies in developing countries would reduce global oil demand (and the associated carbon pollution) by about 5 percent, Aldy says, and thus lower the price of crude oil worldwide. Critics have claimed that getting rid of the tax provisions will cost jobs, reduce U.S. energy security, and hurt small businesses, but he says that is not what economic history shows.

"If you just look at the track record of these subsidies in the U.S. tax code and what's happened to U.S. production over the last 40 years...[there is] basically no correlation," he reports. "The problem is that the current tax breaks do not target new technologies, nor do they target pollution-reducing technologies. The current tax breaks are indiscriminate and apply even now, when oil prices have been at their highest all-time levels over the past

The Top Three Tax Breaks That Subsidize Fossil Fuel

HMD For a list of the 12 tax subsidies that Joseph Aldy would eliminate, see harvardmagazine.com/2014/01/taxbreaks. Ending them all, he says, would reduce the U.S. deficit by $41 billion in 10 years.

Tax Provision	Lost tax revenue over 10 years*
1. Expensing intangible drilling costs	$13.9
2. Domestic manufacturing tax deduction for oil and gas	$11.6
3. Percentage depletion for oil and gas wells	$11.5

* in $ billions (estimated)
Source: OMB (2012)

five years. They enrich firms that would have drilled wells anyway. In fact, the impact on U.S. production is negligible."

If the subsidies were eliminated everywhere, global oil consumption could fall by more than four million barrels per day—benefiting consumer nations, including the United States. In addition, global carbon dioxide emissions contributing to climate change could fall about 7 percent by 2020 and about 10 percent (more than five billion tons of carbon dioxide per year) by 2050. "If the U.S. could actually deliver on what the president committed to in 2009, and...get rid of these production subsidies," he says, "it has the potential to leverage a lot of change and behavior in other countries."~LAURA LEVIS

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KICK, IN THE PANTS

Wearable Robots

A soft robotic glove intended for hand rehabilitation therapy uses fluid-powered elastic tubes to mimic finger movements.

"ROBOT" SUGGESTS constructions of synthetics and steel, from enormous machines on factory floors to the Roombas that vacuum floors at home. But assistant professor of mechanical and biomedical engineering Conor Walsh has a different kind of robot in development. Walsh, a core faculty member at the Wyss Institute for Biologically Inspired Engineering, is creating soft robots designed to aid human movement; they are light, efficient, and built into the fabric of clothes.

In one project, funded by the Defense Advanced Research Projects Agency, Walsh's group and collaborators are designing a robotic exosuit to improve the endurance of soldiers, who routinely carry heavy packs. The invention may also help patients with motor impairments, who often have difficulty walking. The idea of a wearable robot is not itself new, but previous versions were known as "exoskeletons," because they typically used rigid outer frames for support. That design, Walsh notes, can compromise the very purpose of the suits: their restrictive machinery and large battery packs only add to the load.

His lab is instead building minimalist, flexible robots that make use of the body's natural, pendulum-like mechanics during walking—an approach, he says, that allows the robots to operate more efficiently. "Say you have someone on a swing, and you want it to move back and forth," he explains. "If you grab the swing and physically keep it moving through its trajectory, you'll have to expend a lot of energy. But if you start a person swinging, then you just have to give a little tap at the right time, and the swing will keep moving."

The lab has produced an adjustable suit made of nylon, polyester, and spandex that is strapped snugly around the user's hips and thighs and connects to boots at the heel. When the wearer walks, sensors embedded in the insoles send a signal that is relayed up the body to an actuator box, which can be clipped onto a backpack or waist belt. A computer processor tracking the user's gait tugs (using motors and pulleys) on cables strapped at the hips and ankles to provide well-timed bursts of power, thus reducing the energy needed for walking. "We're not trying to make sure that we carefully move the leg to a precise position," Walsh says. "Rather, we just want to give a little kick or burst at the right time." The exosuit currently runs on ap-

Conor Walsh's lab is designing a robotic "exosuit" to aid human movement; soft and lightweight, it can be worn under clothes.

Photographs courtesy of Conor Walsh