

the seats, and save steel by using custom-made parts. It was more than just a cheaper car; it was a radical rethinking of how to build one. As innovations go, the Nano was arguably a greater achievement than the \$40,000 Volt.

One observer who agreed with this assessment was C.K. Prahalad, the management guru touting “the fortune at the bottom of the pyramid”—the four billion strivers living on less than \$2 per day. Don’t treat them as charity cases, he instructed readers in his books, but as consumers. Don’t dismiss them as too poor for your products; collaborate on creating new ones. Size up the constraints—price, performance, scale, resources—and then work within them, what he called the “innovation sandbox.” This was the key, he argued, to unlocking the human potential of billions. “It is this approach to innovation—embracing constraints and leveraging them for breakthrough innovation—that got us the [Nano],” he wrote in an early celebration of the car, “in spite of the dramatic increases in the price of raw materials.”

Within that qualifier, however, lay a hint of innovation’s darker side, the never-ending rise in consumption in spite of—or rather, because of—breakthroughs like the Nano. The people’s car made mobility both more efficient and more accessible, threatening to vastly increase the number of vehicles on the roads—itsself an unintended consequence.

Prahalad, who died last year, didn’t understand why environmentalists recoiled

at the prospect of millions of Nanos added to India’s already-choked roads. “I think this is the wrong starting point for the debate,” he wrote, suggesting instead that the problems of burgeoning auto ownership might inspire their own breakthroughs.

But what if innovation is inherently unsustainable? The British economist William Stanley Jevons first diagnosed this dilemma in 1865’s *The Coal Question*, arguing that more efficient steam engines would drive down the cost to run them, thereby increasing coal consumption and eventually precipitating a crisis we would call “peak coal” today. Doing more with less is the essence of innovation, but the so-called “Jevons Paradox” means we do more with less—and then more.

This is what we call progress—a burst in productivity around a new innovation, trickling down as its costs fall and it achieves widespread adoption. We implicitly assume unsustainable consumption occurs at the top, not the bottom—in the form of a gas-guzzling SUV, not the Nano. But the Jevons Paradox suggests the opposite is true. If so, Prahalad’s mantra that the biggest gains come in the smallest packages only threatens to make the problem worse.

UBIQUITY RISING

Around the same time the Nano hit showrooms, India experienced a cell phone boom. A glut of inexpensive Chinese-made handsets sparked a brutal price war among carriers, driving the cost of calls down to

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as little \$.006 per minute. In 2006, India had 150 million subscribers, according to the Boston Consulting Group, but by the end of 2009, it had more than tripled to 507 million.

There is no question that cell phones have transformed the lives of India's poor, quickly becoming an all-purpose device for work, banking, and even health care. This penetration suggests that cheap Chinese handsets could save billions of dollars (and carbon emissions) by rendering old infrastructure obsolete. They are also becoming most Indians' gateway to the Internet, used for the familiar diversions of playing games, downloading music, and keeping tabs on social networks.

All of these functions live in "the cloud," on the servers of Apple, Facebook, and Google, and each in turn is racing to build bigger, more efficient data centers supplied by cheap electricity, which typically means coal. Their aim isn't to conserve energy, but to plow their savings into the next generation of bandwidth- and power-hungry services. Greenpeace estimates the cloud already consumes more electricity annually than all of India and is poised to more than triple by 2020—an amount greater than the current combined demands of France, Germany, Canada, and Brazil. In other words, the digital tools hailed by development experts as a means to reduce the environmental footprint of the "Next Billion" are poised instead to become one of the greatest sources of it. Another unintended consequence.

Jevons' ghost lurks behind every innovation, whether it's Moore's Law—which drove down the price of microprocessors until they were effectively everywhere—or fuel economy regulations. Since 1975, when the United States first mandated Corporate Average Fuel

Economy [CAFE] standards in the wake of the OPEC embargo, the number of miles traveled by vehicles has more than doubled. Like music in the cloud, Americans chose not to pocket the miles-per-gallon they saved, but to consume more of them, leading to the vast exurban landscapes created after a pair of oil shocks and which now must be maintained by an even more efficient vehicle, the electric car.

Now that it's India's (and China's) turn to drive, the International Energy Agency predicts that non-OECD countries will account for 93 percent of the growth in energy demand going forward. Meanwhile, the IEA's top economist believes the world has already passed peak oil production.

Whatever happens, it won't be the Nano's fault. The "people's car" is a dud, selling fewer than 10,000 per month, having been eclipsed by bigger and more expensive models from Suzuki sporting power windows and air conditioning. Still, the Nano might go down in history as the car that whetted poor Indians' appetite for driving. "The bottom of the pyramid continues to be where the action is," the editor of *Autocar India* told the *New York Times*. "But the aspirations of people are moving up."

USER-CENTERED INNOVATION

Untangling the Jevons Paradox will require more than just technical accomplishments, or we will simply defer the problems of consumption into the future. "If we wait for market analysis to tell us what is sustainable, we will wait forever," insists Roberto Verganti, a management professor at Politecnico di Milano and the author of *Design Driven Innovation*. He is critical of what he calls "user-centered innovation," the approach taken by Tata and multinationals such as Proctor & Gamble,

which operates a simulated hutong—a typically Beijing alleyway—in its Beijing R&D center to observe the diaper-changing and tooth-brushing habits of its customers. “Radical change doesn’t come from users,” says Verganti. “Are there any other models for sustainable transport? Of course there are. But if you ask users, they will tell you they prefer to own a car.”

Radical innovations, Verganti suggests, require changing our very understandings of our objects of desire, which in turn depends on sensing or anticipating tectonic shifts in the larger culture. His paragons are companies like Apple, which dictate our desires rather than follow them.

But Apple’s success poses an even more troubling question. The iPhone and the iPad—both category killers—are the products of a seamless fusion of hardware and software, each developed in-house and optimized for the other. An unintended consequence is their non-replaceable batteries, which spurs many users to throw the devices out when the battery dies, not when the rest of their phone ceases to be functional. If Apple is the world’s most innovative and admired company, as many would suggest, then perhaps the logic of rapid, market-driven innovation itself is flawed.

“Finding sustainable solutions isn’t about discovering new, ever-more disruptive ideas,” argues Jens Martin Skibsted, founder

of the Danish design firm Skibsted Ideation. “It requires the opposite, something very un-American: standardization, slowness, and centralization.” Standards are necessary for any cradle-to-cradle recycling scheme or other forms of infinitely replenishable consumption—but they are the enemy of competitive differentiation. Well-designed products may last longer, but the corporate obsession with speed-to-market has shortened their lifecycles to the point where a growing number are obsolete before they even hit the shelf.

It may prove impossible to decouple innovation from consumption. The alternatives proposed by Prahalad, Verganti, and Skibsted only sidestep the problem, assuming there will always be some future innovation to cope with unintended consequences. While this has produced a world in which seven billion people are living longer, healthier, and happier lives than at any point in human history, it also means we will forever be wriggling free of sustainability.

For its part, the Tata Group is following the world’s cheapest car with the world’s cheapest home. In July, the company announced it would begin selling a pre-fab, flat-pack 215 square foot house that can be assembled in a week, all for just 32,000 rupees (\$720). The company hopes to sell them nationwide in early 2012, and the houses are designed to last only 20 years. ●