



## The Energy Scene in India

Posted by [Robert Rapier](#) on April 9, 2008 - 10:00am

Topic: [Environment/Sustainability](#)

Tags: [brazilian ethanol](#), [ethanol](#), [india](#), [jatropha](#), [peak oil](#), [sugarcane ethanol](#), [sustainability](#) [[list all tags](#)]

As I traveled through India on a recent business trip, the topic of energy was constantly on my mind (as it is every time I travel). I found out some interesting things about *jatropha*, toured a sugarcane ethanol plant, found a wind farm in the middle of nowhere, and encountered a native ethanol skeptic. Here are my impressions.

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### Ethanol in India: Another Brazil

The highlight of my trip was definitely the tour of the Sanjivani sugar cane plant near [Shirdi](#). This could be a model to the rest of the world (with some exceptions) regarding how sustainable ethanol should be produced, as they have the entire life cycle covered.



### Sugarcane Headed to the Ethanol Plant

They take in the sugarcane from local farmers, and they produce sugar. Molasses is a by-product of sugar production, and they ferment that to make ethanol. Bagasse is also a by-product, and this is used to fire the boilers to provide power for the plant. The sludge waste that they produce is composted and mixed with the bagasse ash and given back to the farmers to put on their fields.

As far as I can determine, this is an entirely sustainable process. But the bagasse is the key to the entire operation.

I quizzed them quite a lot about the bagasse boilers, and what I was told is that because the sugar extraction process produces very finely ground bagasse (I walked out of the plant covered with bagasse dust), and because the ash content in bagasse is very low - it is an ideal feed for the boilers. Very few sources of biomass fall into the category that 1). It is necessarily removed from the field as a by-product of the cultivation; 2). The resulting process pulverizes the biomass (not only does this make it easy to burn, but it dries easily as it passes through flue gas on the way into the boiler); and 3). The ash content is very low, minimizing maintenance of the boilers. This makes sugarcane ethanol a truly unique production method, and not something that is easily transferred to corn or cellulosic ethanol.

Not only were they making ethanol (95%; not fuel grade) but they had an entire chain of ethanol derivatives that originated from the sugarcane ethanol. These derivatives included important industrial chemicals such as acetic acid, acetic anhydride (very important in my current job), acetaldehyde, and ethyl acetate.

As mentioned above, the grade of ethanol that they primarily produce is industrial grade. This differs from fuel grade for blending in that the ethanol-water azeotrope isn't broken; the final product is 95% ethanol and 5% water. This greatly reduces the energy usage, as it takes a lot of effort to get out that last 5% water. This is in fact the concentration [that Brazil primarily uses for fuel](#), and makes the energy balance much more favorable than using anhydrous ethanol. For blending with gasoline, it is not a good option as the water will phase out. But for dedicated ethanol vehicles, the 95% grade seems to be a reasonable option for partially supplying the energy demands of many tropical countries.

## **In Search of the Elusive *Jatropha* Plant**

If you are like me, when someone mentions [jatropha](#), India immediately comes to mind. Most *jatropha* stories that I have seen mention [India as leading the way](#) on *jatropha* development. For a while, I had no reason to question these reports, but recently I started developing some doubts.

The doubts started when I was contacted by a biodiesel company in Turkey. They had shut down operations because feedstock costs had gotten too high, and they asked if I could help them find an alternative source. I asked them if they have looked into *jatropha*. They said they had, but weren't able to locate anyone in India who could supply them. I thought this was odd given what I had heard about *jatropha* in India, so I agreed to look into it for them. I initially contacted a number of people with various Indian and biofuels connections, but nobody could point me to a concrete lead.

So one of the things I intended to do on my trip was track down that elusive [jackalope](#), er *jatropha*. During my trip I asked practically everyone I met, which included a number of people involved in biofuels, and while almost everyone knew what it was, nobody could point to anyone who was actually producing it. I thought this increasingly odd, given the hype I had heard regarding *jatropha* and India.

Those who did know a little about *jatropha* in general, said that the problem is that the fertile land is being utilized to grow food (a billion people need a lot of land for food) and the marginal land typically has no roads or other infrastructure that could support a *jatropha* industry. While I did see a lot of seemingly marginal land as I drove around, it was pretty remote. Furthermore, I was told that *jatropha* requires about 3 years to produce, and not many farmers are likely to be

willing to tie up their land for an extended period on an unproven crop.

So, while this doesn't mean that there is no potential for *jatropha*, I left the country feeling that the *jatropha* situation in India has been highly overstated.

### **Transport: Mostly by Foot**

Based on my observations, the vast majority of transport in India is by foot. I traveled pretty deeply into rural India, and almost everywhere I went there were always vast numbers of people walking along the roads. Motorcycles are abundant, and almost always had multiple passengers. At one point, I saw seven people (five of them young children) all piled onto a single motorcycle.



### **Mass Transit**

In cities like Bombay, auto-rickshaws were everywhere. I rode in one, and would describe it as essentially like a motorcycle with a light-weight body built around it. Interestingly, the one I rode in (maybe all of them are like this) ran off of compressed natural gas. Speaking of which, there were a lot of alternative fuel vehicles in Bombay. I saw many CNG vehicles, and a taxi I rode in once was fueled by a propane tank in the trunk.



### **Sitting in an Auto Rickshaw**

### **A Wind Farm and an Ethanol Skeptic**

At one point we were driving through a very remote area, and suddenly a wind farm appeared. I took some photos. The farm appeared to be very distant from any cities, so I am not sure about how cost effective it was in that location.



### **Wind Farm in Rural India**

One thing I didn't expect to encounter was an ethanol skeptic, but at one of the meetings we had,

(following my questions about jatropha), our host told me that "ethanol for biofuel is India's greatest threat." I asked why, and he said he feared that 1). The demand in the West for biofuel will result in a food versus fuel competition that would devastate India's poor; and 2). That increased ethanol demand would exacerbate [India's already serious water problem](#).

## Food

During the week in India, I had meat twice. The total I had was about 3 ounces of chicken on a pizza. I would have guessed that I would be constantly starving, but the food is very filling, and very good. I haven't had vegetarian like that in the West. At a typical meal, I would have a carbohydrate (usually a flat bread), a vegetable, and a protein. Rice was always part of the meal. But the meals were very nutritious and healthy, so I plan to incorporate some of these meals into my normal diet.

My host (and Bombay native) Kapil Girotra informed me that India is self-sufficient in food. He also told me that 70% or so of the population is vegetarian, which means it requires less land to feed them. On the other hand, I saw a very large portion of the population that certainly is not getting enough to eat. So you might say that they are barely self-sufficient. They do produce enough food to feed their population, but I saw a lot of undernourished people.

## The Poverty

The poverty in India is just stunning. We don't have anything to compare it to in the West. The people that would be considered very poor in the West have it far better than the poor in India. They are literally starving to death. I once asked what happens if someone has a medical emergency in the slums. "*If they have money, they live. If not, they die.*" I just imagined a child getting hit with something incredibly painful like renal colic (and [believe me, it is excruciating](#)) and not being able to get help. I can't imagine the strain on a parent going through that. I would rather have a finger chopped off than stand by helplessly while my child screamed in pain for hours. Seriously.

I think in the West we just tune it out when we see it on TV. But you can't tune it out when you drive by mile after mile after mile of people living essentially in garbage dumps. I think we treat our unwanted pets in the West with more concern than we have for a starving 2-year-old half way around the world. I was frequently asked what I was thinking about, and once I replied "What it would be like to have everyone in India experience a little of America, and everyone in America come see this."

## The Traffic

It really isn't accurate to call it traffic. It is chaos. It's just a free-for-all out there. I would highly caution a Westerner against renting a car and attempting to drive. You will spend all of your time in a state of confusion, and you will hold up traffic while you try to figure out what to do. The constant honking (in lieu of signaling) was unnerving, and I felt at all times as if I should be flipping someone off. For me, Hell would be having to be a cab driver in Bombay for all eternity.

The roads are shared by people, bikes, motorbikes, auto-rickshaws, and cars. I frequently observed traffic going the wrong direction, and it was quite normal to have someone turn directly across your path. We had drivers who took us from place to place, and they would pass people on blind curves and hills, and sometimes they even passed someone in the act of passing someone else. I don't think we have a proper frame of reference in the West for the "traffic" in India; especially in the big cities. And of course this means a constant haze hung over Bombay while I

was there, which presumably gets scrubbed during the monsoon season.



### **Hazy Bombay Behind Me**

#### **The People**

The population density is something else. I once wondered aloud just how many people I had seen on this trip. Kapil, the guy I was traveling with, said "Probably a good fraction of all the people you have ever seen in your life." That is not an exaggeration. We traveled around the country, and with very few exceptions there were people lining the streets everywhere. Several times I would observe a crowd and wonder what was going on, but there was nothing going on. It was just a crowd. But it looked like a constant stream coming out of a major sporting event.

Despite the crowded conditions, I only saw violence once – when a man tried to drag another out of a car after a wreck. The people seem to cope quite well. Crime doesn't seem to be nearly the problem you might expect in a city of that size and population density.

But with that many people comes a great deal of garbage. There was trash everywhere, and most of the time you could smell rotting garbage. One night we stayed well north of the city, but every once in a while my room would fill up with a garbage smell. I presumed the wind had shifted from Bombay.

#### **Travel**

It took forever to get anywhere. You look at a place, and think "It's only 100 miles." 3 hours later, you still aren't there. We spent 20 hours on the road over the course of 4 days. They don't have many rest stops and such with facilities that I could see. But the people I was traveling with never needed them. We would spend 7 hours in the car and never stop for a bathroom break. Needless to say, I limited my water intake on the trip, as I found that bathrooms were treated as a precious commodity. On a couple of occasions when I was in a meeting, I asked for the restroom and found someone standing outside of it, and a sign that said "VIPs and guests only."

I traveled by train as well, after Kapil asked if I was up for an adventure. I thought "What could be so adventurous about riding the train?" It isn't for everyone. If you like hot, sweaty bodies packed in like sardines (and that's in 1st Class), then go for it. It took us an hour to get to our destination, and during that ride there were constantly people hanging out of the open doors, and it was standing room only. I wondered whether the people in 2nd Class were stacked like cord wood.

## Conclusions

India was an eye-opening experience for me. I managed not to get sick while I was there, and I credit my host Kapil for his constant advice on what I should and shouldn't eat and drink. (I don't recommend the buffalo milk, by the way). The contrasts were amazing. Outside a cluster of \$400/night hotels was the worst poverty I have ever seen. I once saw a guy pulling a hand cart and talking on a cell phone. Houses in the slums had satellite dishes on top of them. A number of times we walked down hallways of buildings that looked to be 100 years old and decrepit, and then stepped into one of the most modern offices you have ever seen.

One of the things this trip has done for me is to highlight the importance of efforts to transition to a more sustainable lifestyle and avoid the kind of collapse that is often discussed in relation to Peak Oil. I think if more people understood just how far society could fall - and I saw that in the slums of India - we could get serious about our energy situation in a big hurry.

## Note:

This essay is a summary of some key points. However, for most of my trips I keep a detailed journal for future reference. But I publish them, and the full boring blow-by-blow can be found in two entries:

[India Part I](#)

[India Part II](#)



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