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How Can Los Angeles Adapt to Coming Climate Change?

Climate change can't alter the blue skies or access to the beach and mountains, but it will pose four tangible threats: The summers will grow hotter, the air will be smoggier, there will be more fires, and there will be much less water

By Matthew Kahn

Editor's Note: The following is an excerpt from Matthew Kahn's book Climatopolis.

Los Angeles is a hedonist's paradise. At night, you can cruise the Sunset Strip. Although The Doors no longer play there, you may run into Paris Hilton or Britney Spears before seeing Brad Pitt and Angelina Jolie at a red-carpet event. During the winter, you might venture downtown to watch Kobe Bryant and the Lakers play. Every day of the year you can sit outside at Starbucks and try to identify professional basketball players looking for a latte in West Los Angeles. In spring 2009 I spotted Baron Davis of the Los Angeles Clippers at a Westwood Starbucks (but he didn't seem to recognize me). In fall 2009 I spotted Brian Wilson of the Beach Boys as he strolled in Little Holmby Park (he didn't give me a knowing nod or wink either). I saw Vin Diesel jog past my house not long ago (again, no seeming recognition on his part). Even the dignified former secretary of state, Warren Christopher, didn't recognize me as he got out of his car while parking on my block. These cases suggest that I'm not a VIP, but a player such as you will have the option of ending the night at a party at the Playboy Mansion near UCLA.

During the day, LA also offers a variety of natural pleasures. The outdoors is an essential part of every Los Angeles resident's day-to-day life. Almost every day you can jog along the Santa Monica and Venice paths near the Pacific Ocean. In the afternoon you can go for a mountain climb in Topanga Park in the Santa Monica Mountains. You can walk around in shorts in February, and in the summer there is rarely humidity or a heat wave. If you are depressed, the blue skies and the ocean breeze will cheer you up. Graduate students at UCLA drive me nuts because they surf in February rather than studying or grading exams. The city feels like an unending adult summer camp. Flowers bloom in late February, and you can e-mail your friends in the Northeast and mock them by singing Pink Floyd's "Wish You Were Here." Although everyone is always talking on hands-free cell phones, nobody here actually works for "the man"; LA is not a company town. The largest corporate employers in Los Angeles County are Kaiser Permanente, with 32,000 employees; Northrop Grumman Corp., with 21,000 employees; and Boeing Co., with 15,000 employees. Of course Los Angeles is famous for Hollywood. The motion picture and television show production sector is responsible for roughly 250,000 jobs.1 In a county with 8 million people, this shows that most people are small wheeler dealers.

Almost everyone in Los Angeles was not born here. Many of us are transplants from cold Northeastern cities. Although we differ in heritage and ethnicity, we share a love for the sun and the good life. This city self-selects people who want to live well. With the exception of me, we are well-tanned, physically fit, attractive people. There is an abundance of plastic surgeons; service providers offering you whiter teeth; swimming pools; and life coaches to pluck, wax, and generally improve every part of your body and mind.

Outsiders mock Los Angeles as a city of plagues. They have heard about the car culture, the sprawl, traffic, the smog, O.J., the gangs, the earthquakes, the Malibu fires, the water shortages, and so on. But to residents of Los Angeles, traffic is the only constant menace. Los Angelenos' average one-way commute time of twenty-nine minutes is a result of many people working at home (their zero-commute time balances out the long commutes). On the roads there are many fancy cars both because people can afford them and because people spend so much time stuck in traffic.

To a New Yorker (I lived in Manhattan for thirteen years and in the New York metro area for twenty-five), Los Angeles really is a strange city. Whereas most cities have a downtown featuring a vibrant employment and cultural center, Los Angeles's downtown is not such a magnet. Yes, the Lakers play there, the University of Southern California is there, and Frank Gehry has built a funky Walt Disney Concert Hall there, but these three provide insufficient gravitational force to encourage the rest of Los Angeles to go downtown. My UCLA students tell me that they never go downtown and have no desire to.

I am a recent LA home buyer. I made the brilliant financial move of purchasing in May 2008. When we bought our house, we made an implicit bet that Los Angeles would remain a great place to live and work. I have my fingers crossed. Home prices in Los Angeles are more than double those in other major cities. In 2008 the average single-family home in Los Angeles County sold for $578,000, and 10 percent of the homes in the county sold for more than $1,000,000. There are more than 32,000 zip codes in the United States. Of the top 200 zip codes ranked by average housing price in the entire United States, 45 percent are in California, although only 20 percent of the nation's population lives in California. Twenty of the top 200 most expensive U.S. zip codes are in Los Angeles County, including Beverly Hills 90210.

These high prices are not due to the inherent productivity of working in Los Angeles. In fact, my time spent outside in the sun while in Los Angeles has probably made me a worse economist. Economists at the University of Chicago claim that Chicago's bad weather raises their productivity by eliminating the option of playing tennis. Los Angeles's great quality of life is what drives up local home prices. The average buyer of a single-family house in Los Angeles County in 2008 paid $324 per square foot of interior space. If LA's quality of life declines, my life savings will unravel.

Climate change can't alter the blue skies or access to the beach and mountains, but it will pose four tangible threats: The summers will grow hotter, the air will be smoggier, there will be more fires, and there will be much less water. In other words, as we saw in chapter 3, climate change is going to shift the competitive landscape of cities, and LA is going to take a hit. And the poorest parts of LA are going to be hurt worst of all. But there's a lot we can learn from an examination of LA's probable future—especially the basic lesson that prices matter. Other cities take note. Our tour of LA will show us the key role that market prices of both electricity and water will play in determining this city's fate. In addition, this case study will highlight how government policy (such as binding land use zoning and caps on water prices) can unintentionally hinder adaptation.

Will LA Lose Its Cool?

California's cool summers and warm winters distinguish its cities from the rest of the nation. Southern cities are hot and humid in summer. Midwestern and Eastern cities are cold in the winter and humid in the summer. Nobody wants to be in Houston or Washington, D.C., in the middle of summer. In contrast, in Los Angeles today the average temperature in July is 74 degrees F, with little humidity.

Climate change will likely degrade LA's ideal climate. Leading climate researchers have developed two different models that allow them to predict each U.S. county's average temperature and rainfall by month for the years 2070 to 2099. Two computer models, with the catchy names CCSM Model and H3A1FI Model, bear bad news. Los Angeles County is predicted to be 13 degrees F warmer on average in July by 2070. The problem for current LA real estate owners (such as myself) is that a fair bit of the value of their assets (my home) rests on the fact that relatively few areas in the United States feature warm winters and cool summers. In the future LA's climate will look like Jacksonville, Florida's, climate today. This is bad news for my housing wealth.

You might try to soothe my spirits by reminding me that all cities will face hotter summers. Unfortunately for you, dear reader, I know the lost art of statistics. I have crunched the data to study the relationship between county home prices and county climate conditions. What jumps out from this analysis is that areas with cool summers and warm winters command a huge real estate price premium. There are relatively few such areas (mostly in California), and they are in high demand. Climate change is predicted to strip away much of California's climate uniqueness, and therefore will strip away the housing price boost that comes with that climate. Mean July temperatures close to 90 degrees F by the late twenty-first century will force down relative real estate prices to reflect underlying changes in climate amenities.

Climate change will cause the most "amenity havoc" for cities in California. San Francisco, San Diego, and Los Angeles are all expected to be big climate amenity losers. The one piece of good news is that California's major cities are not expected to become much more humid. Climate experts do not believe that there are any plausible scenarios in which California becomes much more humid in summertime in general. After all, climate change is not going to change the fundamentally dry subtropical climate of this region in summer.

In contrast, cities in Florida will actually experience an improvement in their climate bundle as winter temperatures increase (an amenity) and summer average temperatures rise relatively little. Only three major U.S. metropolitan areas are expected to experience an improvement in their climate bundle due to climate change. These are Las Vegas, Fort

Lauderdale, and West Palm Beach. In the case of Las Vegas, its climate bundle will improve because of predicted increases in rainfall. A critic of these climate prediction models would be appalled that they predict an average temperature over an enormous land area such as Los Angeles County, which is more than 4,000 square miles. By definition, such an "average" prediction must mask huge variations. In areas of West Los Angeles such as Santa Monica and Malibu, the cool breeze off the Pacific Ocean will cool the expensive homes of the elite. But inland, in East Los Angeles and the San Fernando Valley, temperatures already soar into the 100s in summer and are likely to be much hotter in the face of climate change. This suggests that small pockets of West Los Angeles, such as expensive Santa Monica, Brentwood, and Westwood, could actually grow more valuable as the rest of Los Angeles becomes less inhabitable. Millions of people who live in expensive San Fernando Valley homes will suffer from home price declines as their climate amenity premium vanishes.

The poor and immigrants will bear the brunt of exposure to heat waves and midsummer extreme temperatures. As a point of comparison, consider the Chicago heat wave of 1995, which disproportionately killed members of elderly poor black households in the center city. They did not own air conditioners, and their fear of crime led them to not open their windows. The public health consequences of such heat waves depend on whether "victims" know that a heat wave is coming and have access to coping strategies. Not everyone can jump on a plane and head to Idaho for a week during the peak heat.

We count on public service announcements to alert people of an impending event, such as a smog alert (when ambient air pollution is expected to be above a critical threshold level that threatens public health) or a heat wave, or in Asia that a tsunami is brewing. But how do we inform groups that face language and cultural barriers? In inland Los Angeles, the population is mostly Hispanic. Many of the members of these households do not speak fluent English, and some are in the United States illegally. Such individuals are unlikely to be interested in or willing to follow information provided by government sources. These are exactly the people who are most at risk from the shock. Fortunately, community-based NGOs have stepped up to fill this void. In Eastern Los Angeles, one example is the Esperanza's Community Health Programs, which has been involved in the community by providing access to health information. Such unheralded "little guys" help a diverse city prepare for heat wave challenges.

The Return of Smog?

Given its topography and climate patterns and the scale of economic activity in the metropolitan area, the Los Angeles Basin suffers from some of the highest levels of air pollution in the United States. During the 1970s, before the introduction of stringent new vehicle emissions regulation that began in California in 1972, LA was the smog capital. Millions of people were driving high-emitting vehicles. Polluting oil-refining activity in the Long Beach area contributed to the local smog problem. Old, dirty diesel trucks carrying goods from the Port of Long Beach to consumers around the United States helped to scale up deadly particulate matter concentrations.

In the 1970s and early 1980s, smog levels were awful in Los Angeles. Starting in the mid-1990s, ambient ozone declined sharply in Los Angeles County. Across eight monitoring stations that monitored ambient ozone in 1980 and in 2000, the average annual pollution daily excedence (when air pollution exceeds the Clean Air Act standard) count for these eight monitors declined from 103 days per year to 13 days per year.

These pollution gains are especially notable because between 1980 and 2000, the Los Angeles Basin's population grew by 42 percent and total automobile mileage grew by 88 percent. Vehicle emissions control regulation deserves a lot of credit. New cars today are 95 percent cleaner than new cars built in the early 1970s. These emissions control improvements persist over time even as the vehicle ages. Put simply, emissions per mile of driving have decreased faster over time in Los Angeles than miles driven have increased.

Climate change could reverse some of this progress. The details of atmospheric chemistry concerning how volatile organic compounds and oxides of nitrogen mix to form ozone are complicated, but it can be said that heat waves are likely to cook up more summertime smog. Smog problems will grow the most away from the ocean, in East Los Angeles. Relative to West Los Angeles, East LA's communities are poorer and have more Hispanic residents. Due to this differential pollution exposure across demographic groups, climate change will bring environmental justice concerns to the forefront.

It is no surprise that wealthy, white households live in cool, clean West Los Angeles, while poorer Hispanics are more likely to live in the hot, smoggy eastern section of the city. For homes that sold in 2008, the average price of a home declined by 1.4 percent with each kilometer of distance from the beach. This housing price gradient guarantees that wealthy people will cluster closer to the high-amenity area. If climate change increases smog exposure for poor minorities, this would reverse twenty years of progress in achieving environmental justice goals due to effective Clean Air Act regulation. In earlier work, I documented that between 1980 and 2000, the average Hispanic household in Los Angeles was exposed to thirty fewer smoggy days a year because of disproportionate improvements in air quality in

communities where Hispanics tend to live. Climate change may reverse this progress.

In Malibu, Barbra Streisand had access to clean air even in the early 1970s when the rest of the metropolitan area was terribly polluted. The Clean Air Act's success at reducing smog over the last thirty years has had little effect on Malibu and other coastal communities. Instead, it helped to bring about convergence between inland areas and the cool, clean coast. Clean Air Act regulation has narrowed this air pollution exposure gap between the haves and the have-nots. This is another of the main lessons that LA can teach us: climate change is likely to affect the poor far worse than it does the rich. If Malibu did become unlivable for a few weeks a year, perhaps due to high heat or smoke from nearby fires, then Streisand and friends could retreat to a bucolic Montana cabin.

The Death of Green Grass?

When I lived in New York City, I had never heard of koi ponds. Having lived in Westwood for three years, I am now an expert on them. They abound in Los Angeles. Although it rains only 11 inches per year in Los Angeles, millions of its residents expect to be able to shower, flush their toilets, water their beautiful lawn's grass, play golf on green fairways, and swim in Olympic-sized private pools. As incomes in this mega-city have grown, people have come up with new ways to consume water, including garden waterfalls that help block street noise.

Despite the fact that it rarely rains in Los Angeles, households in this desert area have no incentive to view water as a scarce commodity. They are charged less than one cent per gallon of water. Public water authorities refuse to engage in "price gouging," which makes voters happy in the short run—we get to enjoy our swimming pools and ample green grass. But it means that a day of reckoning lurks in the notso- distant future. Low prices remove any incentive to get "lean and mean" and reduce one's water use. This low pricing creates a culture of waste. When my family goes for a walk in our neighborhood near UCLA, we are amazed at the gallons of water being used for watering the lawns and, due to broken pipes and other mishaps, just flooding the roads. Los Angeles has created a "hot line" for reporting such water wastage. Like an Eastern European living under communism, I have reported my neighbors to this "Secret Water Police." Why? Although I dislike my neighbors, I especially dislike their wasting a scarce resource for no good reason. But nobody from City Hall has ever gotten in touch with me, and nobody has given me a medal.

One of the first lessons taught in an introductory economics course is that prices signal scarcity. Climate scientists are emphasizing that climate change will make water a much scarcer resource in the American West. In California, there is great concern about climate change causing the melting of the Sierra Mountains snowpack. This will reduce the state's water supply. When a precious commodity becomes scarcer, the price should go up. When prices are allowed to fluctuate and reflect free-market supply and demand conditions, a low price means that a given commodity is plentiful. The irony is that California is already in drought, but prices are still very low. The reasons for cheap water pricing remain a mystery to me. (But I must confess that I also support Europeanstyle gas taxes; raise them to $2 per gallon, I say.)

A nonprofit called the Metropolitan Water District of Southern California sells the water to LA households. The agency is not interested in maximizing its profits, nor does it seem very concerned right now about preparing for climate change. Needless to say, the agency disagrees with my pricing strategies.

Let's contrast the market for water with the market for high-quality coffee. Imagine if the mayor of Los Angeles seized control of all Starbucks located in his kingdom and ordered them to sell their products at a nickel per cup of coffee. Consumers would be happy for about a day as they received deep discounts on their triple lattes. But when the Starbucks shut down because the branches were losing money, the consumers would wish that the mayor would privatize this sector again and let prices rise. Because the Metropolitan Water District does not prioritize earning "profit" (revenue minus costs), the artificially low water prices can persist for a long time. These low prices lull California water consumers into a false sense that the water will continue to flow.

That attitude affects all (or nearly all; I'm exempt, but I'm an economist) Los Angelenos. Consider the case of Tony Villaragosa. Mr. Villaragosa is a successful UCLA graduate and is the mayor of Los Angeles. He is actively pursuing policies to make Los Angeles a "green city." Yet this mayor used 386,716 gallons of water at his Mount Washington home in the year before he moved into the mayor's mansion in October 2005. His water consumption was roughly double that of other households with similar-sized lots who live in his area. I would not call the mayor a hypocrite; I would say that he has responded to low water prices by not conserving. He is not alone. Of the 45,000 single-family homes in Los Angeles County that sold in 2008, 16 percent had swimming pools. In the subset of these homes that sold for more than $1 million, 35 percent had pools, and 46 percent of homes that sold for more than $5 million had pools. Presumably the founding fathers did not view private swimming pools as an inalienable right.

How Do We Allocate Scarce Water?

Growing Southern California faces a fundamental water challenge. If we are serious about getting ready to adapt to climate change, then we must allow the prices of water and electricity to reflect their true scarcity. By reducing the supply

of available water, climate change will create an imperative, forcing reluctant governments to recognize that water prices must reflect the basic fundamentals of supply and demand. If demand is rising (due to income and population growth) and supply is declining (due to climate change), then the water authorities face a choice between allowing prices to rise or setting up a complex rationing scheme. Rationing makes economists nuts because it is the equivalent of handing a vegetarian a meat pizza to eat and telling the vegetarian that he or she cannot trade it to a meat lover. The authorities are struggling to cope with these expected imbalances in supply and demand caused by ongoing economic growth and climate change.

The irony here is that you can pick up the *Los Angeles Times* once a week and see an article bemoaning California's "water shortage." In response to this "crisis," cities within the Los Angeles metro area such as the city of Long Beach have adopted serious water rationing policies, including limiting lawn watering to Monday, Thursday, and Saturday and placing time limits on the hours and timing when watering can take place. Any watering must be done between 6 P.M. and 7 A.M. and cannot last longer than ten minutes. People cannot wash down driveways, sidewalks, parking areas, patios, or other outdoor areas with water from a hose. Restaurants can only serve water upon request. Overwatering lawns to the point that there is runoff is illegal.

Starting June 1, 2009, the Los Angeles Department of Water and Power has proudly announced that it is using prices to address the water shortage. To protect lower-income consumers, the first tier's prices remain unchanged, but the second pricing tier will increase by a whopping 44 percent. The message is clear: the DWP is doing something. But it's not as impressive as it sounds.

In the case of water pricing in Los Angeles, something strange is hidden within the rate structure. People who live on larger properties pay less per gallon of water. Permit me to give you an example that strikes close to home. I live in the 90024 zip code. My home is within a half mile of Candy Spelling's $150-million mansion. She is the widow of Aaron Spelling (the father of *Charlie's Angels* and of Tori Spelling) and is seeking to sell her home.

Let's compare our respective water pricing schedules. According to the DWP pricing schedules, to remain on the first tier (the low pricing of water), you must know the square footage of your lot size and how many people live in your house. During the dry months of June to Halloween, homes whose lots are 7,500 square feet or smaller face a first-tier limit during the winter and spring of 28 x 748 gallons (every two months), whereas those who live on properties with a lot size of 43,560 square feet and larger (like Candy Spelling) stay on the first tier until they consume 76 x 748 gallons.

A gallon of water is a gallon of water, and we should each pay the same price for using it. The state knows that it is in the middle of long-term drought. Leading researchers see a similarity between water conditions today and events during the twelfth century, when a particularly severe drought in Southern California was coupled with persistent low flows in the Sacramento and Colorado rivers, a situation that lasted about sixty years. Los Angeles has set up a system whereby rich people who own more grass actually pay a lower price per gallon of water consumed. In my "real world," when Candy Spelling and I each show up at the Westwood Starbucks, we each get charged the same price for an espresso. Facing this price, we make a "take it or leave it" decision. Unlike this "fair" pricing, she pays a lower average price per gallon of water than I do, because she has a bigger house! She is getting a better deal than me because she owns more grass! Implicitly, I am paying for a lot of watering of her grass. I present this case study not merely to earn your sympathy. My goal is to call out government for the unintended consequences of its policies. Climate change adaptation will be more difficult in Los Angeles because of its current policies.

Many environmentalists assume that big business is the cause of our environmental problems and that wise regulating government is the only honorable agent that can force these bad guys to act in the public's interest. But in this case it is government policies that are causing the adaptation challenge.

Economists love to talk about the consequences of bad incentives, but this borders on funny. There is serious drought in the West. Higher prices for water could encourage demand-side conservation. The Los Angeles Department of Water & Power is not doing its part to "solve" the problem. If the LADWP treated everyone equally and charged everyone the same price per gallon of water, or at least exposed everyone to the same tiered pricing schedule, this agency would either collect a lot more revenue from water sales to the rich with large lots, or owners of private "golf courses" (those with big swimming pools and lots of grass) would cut back on their water consumption.

Although they are wimping out on explicitly raising water prices to reflect "true scarcity," the California water providers are trying alternative incentive approaches for reducing water consumption. California households are offered a variety of rebates for "green" appliances, including:

* high-efficiency clothes washers;
* high-efficiency toilets;

* weather-based irrigation controllers, or “smart” controllers;
* rotating sprinkler nozzles; and
* synthetic turf (limit one-half acre).

These rebates encourage replacement of old, inefficient durables with these water-conserving devices, but this well-meaning “green” subsidy may actually increase water consumption when people continue to face a low price per gallon of water. People may now do more wash (and hence use more water) because the price per wash has declined. To illustrate this point, consider a car that needs one gallon of gas to drive 1 mile. If the price of gasoline is $3 a gallon, then owners of this gas guzzler will pay $3 to travel 1 mile. If the household is given a vehicle that can travel 30 miles per gallon, the price per mile falls to 10 cents per mile. If this household responds to this large drop in the price per mile by driving much more, then its total gasoline consumption could increase because it purchased a more fuel-efficient vehicle! Although I doubt that this “boomerang” effect is large, this example highlights the consequences of pursuing indirect means of reducing household resource consumption rather than simply using prices.

The water utilities are trying to incentivize people to economize on water and electricity consumption, but they are tying one hand behind their backs by taking the best policy option (higher prices) off the table. My mother-in-law got a chuckle recently when she received a check from her California water provider. This money was a reward for “saving water.” According to her water bill, she had sharply reduced her water consumption relative to her baseline consumption. The water provider concluded this by comparing her recent water consumption with her previous water consumption (perhaps the previous year) over the same time period. What the water authority did not know was that she was in Italy for the entire billing cycle. She had not changed her day to day behavior; because she was out of the country, she was not using PGE water to flush the toilets, water the yard, or take a bath. But the water authority is not Big Brother. It does not know why her water consumption decreased (as determined by her Berkeley water meter falling to zero). Without knowing the true cause of her “conservation,” PGE sent her a check that she would say she doesn’t deserve.

Engineering Solutions to Water Shortage?

Rising water prices would trigger innovation that could take some odd turns. There are new water technologies that can effectively increase the supply of water. Today, water desalinization is quite expensive. Somehow water recycling has been tarred with the name “toilet to the tap”—which is actually an accurate description of the idea.14 Certainly anyone who doesn’t trust engineering techniques would wonder whether the water is contaminated with fecal matter, but those who do trust the technology would be happy to guzzle it. Despite the science behind water recycling, in the late 1990s the Los Angeles mayor scuttled a plan that would have used this technology and mitigated water “shortages” in the city, because he was worried about voter backlash from the grossout factor.

Today engineers continue to try to push support for projects such as the reuse of “gray water.” Light gray water is wastewater from the shower, bath, bathroom sink, and clothes washer. Heavy gray water is wastewater from the kitchen sink and dishwasher. Commercial technologies already exist for processing both light and heavy gray water on-site for nonpotable usage. Although the water produced is not clean enough to drink, such technologies effectively increase our supply of water for other basic uses. This is quite valuable in a world where water will become scarcer.

Engineering solutions to the challenges that Mother Nature poses are not always embraced. Consider putting fluoride in the water supply. This has helped to sharply reduce cavities and other tooth decay problems. Recently economic research has documented that people with more teeth earn higher wages. Differential access to fluoridated water during childhood offers a “natural experiment” for testing how this public health intervention affects long-term quality of life. One research team used adult wages as their key outcome measure and found that women who resided in communities with fluoridated water during childhood earn about 4 percent more than women who did not live in communities with fluoridated water.

Although this may not seem surprising to you, such research is necessary to help make the case that public health strategies such as putting fluoride in water improve our health and well-being. But controversy has arisen over this strategy. Some potentially valid concerns have arisen, such as that fluoride intake is not easily controlled and that children could be overdosed. Other objections make less sense. In the 1950s, it was argued that water fluoridation was part of a communist plot.

Climate change will force Californians to have a serious policy discussion about water priorities. As water supplies decline, and if people reject engineering solutions such as the “toilet to the tap,” what is to be done?

Will California’s Farmers Bail Out the City Slickers?

California farmers offer one possible source of supply. It is well known that 80 percent of the state’s water goes to agriculture and that 40 percent of the state’s water goes to growing four crops: cotton, rice, alfalfa, and pasturage (irrigated grazing land). These four crops account for only 1 percent of the state’s annual income. Urbanites generate

California's wealth, but historical property rights allocations have granted the increasingly scarce water to farming interests.

An economics 101 student would say, "Let me get this right. Farmers have the property rights to this water and are growing low-profit crops such as alfalfa and strawberries while thirsty urbanites are willing to pay more than ten times as much for this same water that the farmers are using? Let the farmers sell their water to the urbanites and then California's cities will suffer less from climate change."

Unfortunately, many remember the "Theft of Owens Valley." Although these events took place in the 1920s, farmers have long memories. If water sellers today believe that past farmers did not receive a good deal from the first great water transfers, this will discourage trade today in water transfers.

The Owens Valley case continues to generate wide academic and popular attention. Consider the movie *Chinatown*. This Oscar-winning film helped Jack Nicholson pay for his Lakers front-row court seat and to perpetuate the myth that corrupt LA stole its life-sustaining water supply from unsuspecting Owens Valley farmers. Although leading economic historians have reevaluated and rejected this version of what happened, the "fact" remains that in the past city slickers outfoxed the rural farmers in a lopsided trade that led to the urbanites' being enriched at the rural area's expense. To quote *The Who*, "We won't be fooled again."

Today's farmers are worried that history will repeat itself as they are suckered by the "big city" sophisticates into a deal that takes their water at too low a price. Climate change will make California's urbanites more desperate to find sources of water, and the farmers will have property rights to California's scarce water. A farmer who seeks to maximize profits would diversify his or her portfolio of assets and substitute growing less water-intensive crops and selling surplus water to the thirsty urbanites at a high price. Such privately beneficial actions by the farmer will help Southern California's cities adapt to climate change.

Come on Baby, Light My Fire

When the Santa Ana winds pick up, you know it. These are surprisingly hot winds, with gusts of 40 miles per hour or higher. The streets of Los Angeles smell like a Boy Scout fire. The odor one smells is not S'mores cooking but rather Malibu homes ablaze. These fancy homes are located in fire zones. The rest of the country fixates on great television videos of multi-million-dollar Malibu celebrity homes burning down. Local media reports have reported that actors Matthew McConaughey and Minnie Driver were among those forced to evacuate in a recent fire, and Red Hot Chili Peppers bass guitarist Flea's home was destroyed by the flames. A text message from the rock star said his US$10.5-million mansion had "burnt to a crisp."

Today, climate modelers are uncertain whether climate change will increase fire risk. On the one hand, Los Angeles is predicted to receive 50 percent less rain than it does now, and the combination of less rain and more summer heat means a drier landscape that is more prone to fires. On the other hand, the frequency of Santa Ana winds is predicted to decline as the eastern deserts warm. Within Los Angeles, there is significant variation in the exposure to fire risk. People in the center city of Los Angeles or even Westwood face little risk from these fires, but in other areas such as Malibu, there could be significant fire risk posed by climate change.

There are several possible coping strategies to protect the city against future fire risk caused by climate change. The simplest would be to reduce new housing construction in fire zone regions by requiring homeowners there to pay significantly more for fire insurance. Alternatively, these households could be offered lower insurance premiums if they build their homes with fire-resistant materials and landscape their property so that their homes are less prone to fire risk. Although I hope that local political leaders would support such "safety first" policies, I am pessimistic that these policies could be adopted. Landowners would complain that these proposals represent a property "taking," stripping them of their development rights and exposing them to the whims of price gouging insurance companies. They would argue that their 3,000-square-foot houses should have the same home insurance premiums as similar homes built elsewhere in Los Angeles. They would say that they are being discriminated against.

On some level, they are right. Different parcels of land face different risks from climate change's new blows. Those who own land in areas that we now know are risky (due to climate change) are losers. I am not convinced that society owes them compensation for losing a bet. Similar to the developers of the St. Louis hotels located in a flood plain, these fire zone landowners want to flip a one-sided coin. They want access to cheap insurance that bails them out if a nasty fire occurs, but they also want the right to live there as if the area is not at elevated risk because of climate change. If we are serious about tackling climate change, we need to design credible incentives to push more economic activity (and multimillion- dollar homes) away from geographical areas that are increasingly at risk because of climate change.

Consider fire protection in California communities at the wildland/urban interface. The biggest danger is where suburban

communities abut forest lands, in counties such as Marin, Alameda, Contra Costa, and Santa Clara. In areas such as the Sierra Nevada foothills and the interior areas in Southern California, the scenery is beautiful but at greater risk from fire as climate change raises temperatures and reduces rainfall. When forest fires occur, a large amount of damage to life and property can quickly take place. California budgets $519 million for fighting wildfires, with an emergency $182-million fund. The state fights the fires with prison inmates; 4,400 are trained each year to do the grunt work. Given California's current large fiscal deficit, the governor has been planning to release prisoners earlier. An unintended consequence of this money-saving plan is a smaller firefighting force.

To my surprise, my California tax dollars are being used to pay for firefighting in this high-risk area. I naively assumed that people who live in these fire zones pay for their own extra fire protection services through local property taxes. But this is not the case. Climate change will increase both the size of these zones and the severity of risk that local residents face in them. Current state policy spreads the cost of this fire protection across all residents in the state. But consider a small change in state fire policy. If local governments in fire zones had to pay for the bulk of their own fire protection, they would change their zoning codes to allow less new development in these areas. This would immediately reduce the cost of climate change–induced forest fires.

Los Angeles Has a Subway?

Public transit is not used in Los Angeles. In the year 2000, only 6 percent of LA residents commuted using public transit. The Santa Monica Big Blue bus charges adults 75 cents and students 25 cents a ride, yet this isn't enough of an incentive to lure mass ridership.

Although the car is cool, a more fundamental reason why people in Los Angeles do not walk, take the bus, or use the subway is that the city is so spread out. Urban researchers have documented that this city has at least sixteen different major employment centers, each with more than 100,000 jobs centered in it. Unlike nineteenth- and early twentieth-century cities, which had a single downtown employment center, the modern city has multiple employment centers. When people work in the suburbs, they are highly likely to commute by private vehicle.

The paradox is that the average Los Angeles resident lives in a neighborhood with 13,100 people per square mile, but few live a "new urbanist" lifestyle of walking and biking to places of work, shopping, and cultural activities. In recent years, the city and federal governments have invested billions of dollars in a subway and light rail system geared to getting people downtown. The Red Line is LA's subway. It was opened in early 1993, with extensions through Hollywood opened later in the 1990s. The total cost of building this system has been roughly $6 billion, or $300 million per mile. Today, 150,000 people per day ride this subway. In contrast, 5 million per day ride the New York City subway.

Today, Los Angeles is considering building a "Subway to the Sea." This east/west subway could take people from Hollywood, west through Beverly Hills, Westwood, Brentwood, and then finally to Santa Monica and the beach. My UCLA students tell me that they will take this subway (which will cost roughly $1 billion per mile) the 5 miles to the beach once it opens. If this subway does cost $5 billion to build, and if it attracts 200,000 riders per year, then after twenty-five years it will have attracted 5 million riders. The average fixed cost of providing this service would be $5 billion divided by 5 million, or $1,000 per rider. Critics would argue that a taxi, even a Beverly Hills taxi, would charge much less than $1,000 per ride.

Of course I am partially kidding. There are environmental and congestion benefits from building such a subway, and the subway would live on for years. But transit advocates must admit that in the absence of huge federal subsidies of up to 80 percent, there would be a serious public policy debate over whether subways are a good investment of scarce tax dollars. The case for building such a costly subway would be stronger if the federal government taxed gasoline to reflect its contribution to climate change. One leading economics study concluded that the tax on gasoline should be $1 a gallon higher than it is today. If the average household consumes 700 gallons of gasoline a year, this extra $700-a-year tax on gasoline expenditure would push some of them to switch from using their cars to taking public transit.

Could Public Transit Become Hip in Los Angeles?

Ridership of a new subway would increase if LA's density increased to match a Manhattan-style density (via higher apartment buildings) on the west side of Los Angeles. Climate change will increase the demand to live closer to the temperate, low-smog coast. If in the near future the United States passes a carbon tax or cap and trade program for electricity consumption and fuel consumption, this will create incentives to live in high-density skyscrapers in West LA locations. In a nutshell, there will be incentives and infrastructure developed to make Los Angeles look more like Manhattan. Given that buildings can live for one hundred years, these changes to the city's urban form will only gradually be noticeable. Manhattan is the densest county in the United States, with an average of 70,595 residents per square mile. If parts of Los Angeles could achieve a similar density, this would create a market demand for fast subways that would be used and pay for themselves. In comparing the carbon footprint of the nation's major cities, New York City has a small footprint. This is due to its residents' use of public transit and living in relatively small homes. Given its temperate climate,

West Los Angeles could have an even smaller footprint if people there lived at Manhattan's density.

Who might demand such new urbanist living? Crime in LA has been on the decline. In the past, suburbanization has been fueled by "flight from center city blight." But this process could reverse. Amenity-seeking young people and empty nesters enjoy the high quality of life in the center city. Households with young children would be less likely to demand such dense apartment living.

If Los Angeles starts to resemble Manhattan's urban form, it could help to reduce this city's notorious traffic congestion. A dense coastal core of high-rise buildings would provide a political constituency who might vote in favor of congestion pricing on LA's major highways.

Despite its well-known traffic congestion, Los Angeles has been slow to experiment with innovative solutions for this problem. In 2003 London implemented the Central London Congestion Charge. Commuters pay a fee of roughly $15 when they enter the center city during peak times. The road charge could vary over the course of the day. At 3:00 A.M., when the roads are empty, the road charge could be zero. Such incentives would help to spread out driving over the course of the day, reducing demand at the peak and increasing demand off-peak. This would increase traffic speeds during rush hour. The revenue collected from such a program could be used to improve public transit. This is the approach that London has adopted. By improving basic bus service (in its frequency and the quality of a ride), London has managed to lure middle-class people to commute using this mode. As public transit is no longer viewed as a poor person's travel technology, any stigma effects vanish, and this further reinforces willingness to commute using public transit.

Outside of dense Northeastern cities such as New York City, Washington, D.C., and Boston, and environmentalist cities such as San Francisco, it is not a stretch to claim that the poor and lower middle class disproportionately commute using public transit. But this is not a constant. Improvement in the quality of public transit and densification would both reverse this long-term trend.

Hurdles: Local Growth Controls

To protect LA residents from climate change, we want to encourage more dense development near the water in coastal communities such as Santa Monica, Venice, Malibu, and Pacific Palisades. These communities are cooler and face less smog than East Los Angeles. The densification of West LA would offer global carbon mitigation benefits.

But wealthy, coastal communities are likely to block new apartment towers. Local cities control land use and permitting for new construction. At least up to this point, these communities have not encouraged such high-density land use. There is a certain irony here. The residents of these communities are pro-green Prius drivers, eagerly installing solar panels on their houses' large roofs. On a day-to-day basis, they are living green and are proud of it. But Barbra Streisand and friends might not welcome thirty-story skyscrapers nearby. By giving their individual communities an implicit veto right on local development, Los Angeles as a metropolitan area loses access to a readily available adaptation strategy.

Consider Santa Monica and Beverly Hills, two beautiful cities located in West Los Angeles. Each has a population of roughly 90,000. Between 1990 and 2008, Beverly Hills averaged permitting 61 new total units per year, while Santa Monica issued new permits for 303 units per year. In this highly desirable community with roughly 30,000 housing units, this is a very small growth rate.

Some claim that the west side of Los Angeles has no land for development, but when I walk from Beverly Hills down Wilshire Avenue to UCLA, I see plenty of land parcels that could be converted from their current purposes into high density housing. In pristine Santa Monica, I see one-story auto repair shops that could be torn down and built up into six-story buildings. If such a building had twelve new units that each sold for $1 million, then the total revenue from this conversion would be $12 million. Could the auto repair shop's present discounted value of its future profits really be close to $12 million? I don't think so. This suggests that binding zoning regulation is inhibiting the conversion of scarce land to its highest value use. This grosses out the economist, and it should also upset environmentalists who are eager to see Los Angeles be nimble enough to adapt to changing climate conditions.

Sacrifice Golf to Save the People

West Los Angeles has other parcels of land that might be more desirable than converted commercial properties. Consider the private golf courses. These large green open spaces are reserved for wealthy golfers. I still like Tiger Woods, and I wish I was in as good physical condition as John Daly, but let's think about what developers could build on the combined prime land at just two golf courses on the west side. Together the Riviera Country Club and the Los Angeles Country Club take up 377 acres (0.6 square mile) of prime West LA real estate. If the land were built up at Manhattan's density of 70,595 people per square mile, it would yield housing for 0.6 x 70,595 = 42,357 people. If on average there are three people to an apartment unit, then 14,119 new housing units could be built there. If each sells for $1 million, the total new real estate would be worth roughly $14 billion. The increase in supply would cause the price of

nearby housing to fall, but this negative supply effect is unlikely to be large. There are a number of people around the world eager to live the West LA lifestyle. Yes, there are tradeoffs. I am sacrificing golf for shrinking our per capita footprint and adapting to climate change. But such densification would create a virtuous cycle, as it would increase the demand and usage of a Wilshire subway. This “Manhattanization” of the west side would offer a variety of medium- and long-term environmental benefits. If West Los Angeles does become more amenable to high density development, there are also fundamental engineering challenges that will have to be addressed. As everyone knows, Los Angeles is prone to earthquakes. Building tall buildings in earthquake zones poses a set of engineering challenges that would have to be tackled.

Readers who love golf may now view me as the great Satan. I apologize for infringing on your constitutional right to play golf in paradise. My real goal here is to encourage a reconsideration of current land use regulations in Los Angeles. With such relatively small changes to status quo policies, this city can make a big push toward achieving a sustainable future in a hotter world.

Prices Matter

A major theme in this chapter has been the importance of getting prices right in our hotter future. I am not talking about Starbucks but rather about basic necessities such as electricity and water. Climate change will simultaneously increase the demand for them while restricting their supply. A consistent irony is that government policy is hindering urban adaptation to climate change. Up to this point, local and federal government policies have not helped our cities prepare for climate change. In both water pricing and electricity pricing, by placing a ceiling on prices and introducing strange implicit subsidies (such as the one directed toward Candy Spelling’s property), Los Angeles and other major cities are choosing not to expose urbanites to real scarcity signals. Los Angeles is risking its green future by its continued mispricing of scarce resources.

My city is not alone in this regard. Similar policies are in place in many U.S. cities. Capped prices matter because many of us need an explicit nudge to change our ways. Behavioral economists emphasize that like Homer Simpson, we are lazy procrastinators. But if we are serious about making a proactive push to adapt to climate change, we must face the truth about rising scarcity in our hotter world.

Further Reading

Can Cell Phones Speed Adaptation to Climate Change?
Weather or Not?: Last Winter's Record Snow Driven by Short-Term Meteorologic Patterns, Not Long-Term Climate Change
Spread of Deadly Cryptococcal Disease in U.S. Northwest Linked to Global Warming
Climate Change May Mean More Mexican Immigration

Ancient Ocean Acidification Intimates Long Recovery from Climate Change
The New Normal?: Average Global Temperatures Continue to Rise
Can Climate Change Cause Conservation?
Heat of the Moment: How Much Global Warming Are We Willing to Take?