Surprising Energy Requirements of the Cannabis Industry

PART I

Implications for Utilities, Regulators

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The legal cannabis industry in the U.S. is experiencing rapid growth. That growth and its commensurate energy demands have surprised utilities, public utility commissions, and government officials. The industry is extremely energy-intensive, and is placing strains on some individual utilities and local grids.

These problems may only intensify in the coming years, due to the success of recent cannabis ballot legalization initiatives in several states. It appears that many other states will be legalizing cannabis in the future.

In Part I, we forecast electricity demands that we believe are likely to be generated by the U.S. cannabis industry. We analyze the problems currently resulting from the immense energy requirements of the industry and their unintended consequences. We then assess some potential implications for the cannabis industry and for utilities.

In Part II, we will discuss possible options and solutions for utilities and the industry.

Macro Implications

We estimate that in 2017, cannabis production may account for as much as three to six percent of U.S. electricity consumption, and as much as five to ten percent in California.[1] Under that assumption, cannabis production would consume more electricity than all data centers and server farms combined. They currently consume between two and three percent of U.S. electricity.[2]

Again using this estimate, cannabis production would account for about six times more electricity consumption than the entire U.S. pharmaceutical industry.[3] In Denver, cannabis production now accounts for nearly fifty percent of electricity load growth.

The industry is extremely energy-intensive, placing strains on some utilities and grids.

Assuming that in 2017 cannabis production accounts for about five percent of U.S. electricity consumption, Figure 1 compares this to electricity demands from other sectors.[4]

See Figure 1.

This figure indicates that cannabis electricity consumption totals nearly two hundred billion kilowatt-hours, and could be more than twenty times greater than transportation electricity consumption. Cannabis production might equal nearly twenty percent of total U.S. industrial electricity consumption, and could be about twice that of server farms and data centers.

However, the Energy Information Administration forecasts that U.S. electricity sales will increase at an annual average rate of 0.6 percent through 2050. This forecast may already be obsolete. Assume that, due to the cannabis industry, U.S. electricity consumption increases annually 0.2 percent higher than the EIA forecast (0.8 percent instead of 0.6 percent) or 0.4 percent higher than the EIA forecast, (1.0 percent instead of 0.6 percent).

In Figure 2, the blue line shows the EIA forecast of electricity sales increasing 0.6 percent annually. The green line shows the Management Information Services, Inc. forecast of electricity sales increasing 0.8 percent annually. The red line shows the MISI forecast of electricity sales increasing 1.0 percent annually.

See Figure 2.

This implies that by 2030, U.S. electricity consumption may be seven to ten percent higher (350-400 billion kilowatt-hours) than EIA forecasts. By 2040, it may be eight to fourteen percent higher (360-600 billion kilowatt-hours) than EIA forecasts. By 2050, it may be ten to eighteen percent higher (450-800 billion kilowatt-hours) than EIA forecasts.

In addition to calling into question all current forecasts of reductions in energy use and greenhouse gas emissions, these

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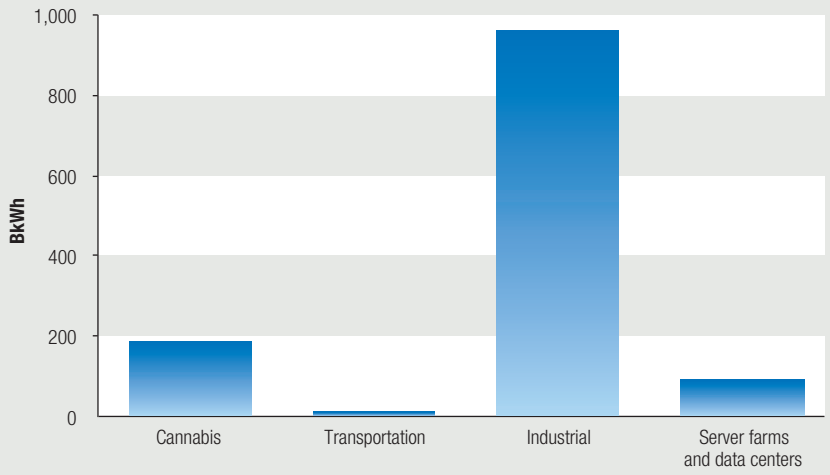
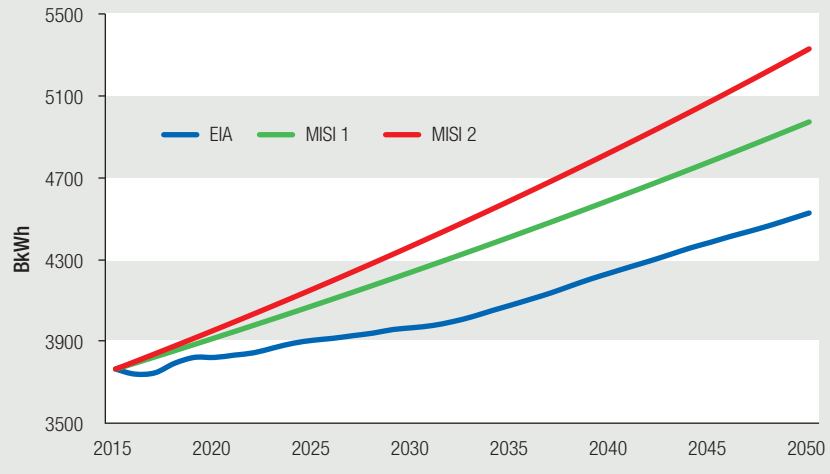
Fig. 1 2017 U.S. Energy Consumption, Selected Sectors



Source: Energy Information Administration and Management Information Services Inc.

Fig. 2 Comparative Growth of U.S. Electricity Sales



Source: Energy Information Administration and Management Information Services Inc.

forecasts would seem to indicate that there is a major uptick in additional power required in excess of the EIA forecast.

By 2030, the U.S. may need the equivalent of forty to forty-five gigawatts of new power plants. By 2050, the U.S. may need the equivalent of fifty to ninety gigawatts of new power plants. And under this scenario, thousands of miles of new transmission lines would also be required.

Utility and Regulatory Issues

No one anticipated the growth in electricity consumption caused by the cannabis industry. In order to deal with the problem and to capitalize on a lucrative new source of revenue, local governments and public utility commissions are instituting a wide array of taxes, fees, and other requirements. Those requirements can greatly increase growers' energy bills.[5]

Colorado's Boulder County has a surcharge of two-point-two cents per kilowatt-hour for cannabis grow facilities. A similar tax has been enacted in Arcata, California, where officials are collecting more than three hundred thousand dollars annually from what is called an excessive energy use tax.

Some utilities in states where cannabis has been legal for several years have established new rate structures for growers. In Boulder, Colorado, licensed cannabis growers must use one hundred percent renewable energy to power their cannabis facilities and, if that is not possible, must pay into Boulder's Energy Impact Offset Fund.

Some states that have legalized cannabis and cities and counties within them are establishing licensing regimes incorporating climate and energy protective provisions and carbon impact assessments. In some jurisdictions, cannabis growers are required to purchase renewable energy credits. Some municipalities are taxing cannabis growers who are said to strain the grid.

The rapid growth in consumption is also causing problems for local utilities. Last summer in Portland, Oregon, Pacific Power reported seven power outages directly attributable to cannabis production, and Portland General Electric experienced similar problems.

Some cannabis operations have overloaded transformers, causing them to fail, resulting in fires. Some utilities are incurring unanticipated costs to meet the demand. To recoup these costs, they are requiring cannabis growers to pay up front for transformer upgrades and other improvements.

Utilities receiving power from federal projects question whether they may legally supply electricity to cannabis producers. Any regulatory agency that receives federal funding risks losing those funds by enacting regulations to facilitate cannabis cultivation.

Several factors contribute to growers' high energy consumption. An indoor cannabis facility consumes six times more electricity per square foot than an average commercial business, and forty-nine times more than an average residence. Electricity can represent as much as fifty percent of a cannabis operator's overhead.

Why don't growers move plants outdoors? Growers desire sunshine-equivalent light, but outdoor operations leave crops subject to the seasons and vulnerable to other risks. Indoor cultivation makes it possible to obtain perfect yields and quality.

There is a growing segment of the industry trying to

benefit from the sun as much as possible by using greenhouses. However, greenhouses still require a large amount of lighting to supplement natural sunlight.

Also, greenhouses are similar to outdoor growing spaces as they relate to cloud cover, weather, and daylight. Greenhouses have thus not led to the significant reductions in electricity consumption that were anticipated.

In many cannabis facilities the atmosphere is calibrated to mimic outdoor conditions, allowing growers to reap multiple harvests a year. It is also standard practice to use powerful, energy-intensive lighting systems.

In this unvirtuous cycle, the intense heat from the lights requires air conditioning and fans to keep grow rooms at seventy-five degrees, a dehumidifier to prevent mold, and a carbon dioxide injection system.

According to the co-owner of a thirty-one hundred square foot medical-cannabis facility, “All these things consume too much power – the equipment, the air conditioning, the lighting, the fans, the scrubber, and the humidifier.” The electric bill for that facility is five thousand dollars per month.

Some states have indoor warehouse operations. A ninety thousand square foot warehouse that provides growing space to cannabis growers paid for a two million dollar rooftop solar array, LED lights, and the most efficient HVAC and insulation products. Nevertheless, the electric bill for this facility is over one million dollars per month.

Energy usually accounts for twenty-five to thirty percent of cannabis production costs, but can comprise nearly half of the wholesale price of cannabis, depending upon the grower, strain, state, and operating costs. As prices fall and margins decrease with increased competition, the share of energy in total production costs will increase.

Profits currently far outweigh costs: A pound of medical cannabis sells for about two thousand dollars on the wholesale market, whereas production costs are only six hundred dollars a pound. Thus, at present, energy costs are usually not a constraint.

Colorado’s experience demonstrates the issues that are of concern to policymakers. Since the state legalized adult cannabis use in 2014, the industry has expanded rapidly. In 2015, Colorado cannabis businesses generated nearly one billion in sales, an increase of forty-two percent from 2014. As cannabis businesses become more competitive and specialized, some growers are moving their farms indoors to produce a more controlled product.

Many facilities constrained by warehouse space are moving to vertical growing. There are warehouses with twenty-foot ceilings and low profile LEDs. The managers stack plants on racking systems three and four high to take advantage of the vertical space. However, this exacerbates problems in energy-strained areas by increasing the electrical load by a factor of four.

Prohibition has also kept energy efficiency technologies from being utilized. Even after legalization, in Colorado new grow installations largely resemble underground operations and investors have been hesitant to provide funding. However, this is beginning to change as innovative entrepreneurs enter the marketplace.

Cannabis operations have joined data centers and electric vehicles as the major new electricity users for the Northwest Power and Conservation Council. The agency, which includes legal cannabis markets in Washington and Oregon, estimated that indoor growing sites would consume as much as three hundred megawatts by 2035, enough to power a small city.

According to the Northwest Power and Conservation Council, in Oregon an indoor grow system for four plants consumes as much energy as twenty-nine refrigerators. Some cannabis operations have overloaded transformers, causing them to fail, and

others rely on diesel or natural gas generators to avoid accessing the grid.

Demand will greatly increase in 2017, since cannabis for adult use has been legalized in California, Maine, Massachusetts, and Nevada. Regulators are grappling with how to address the growth. According to Pennsylvania PUC Commissioner Pam Witmer, "We are at the edge of this. We are looking all across the country for examples and best practices."

The corporatization of off-the-grid narco-agriculture is taxing electrical systems even as some states, such as California, seek to comply with the Paris Climate Accord and reduce greenhouse gas emissions. While things may change on the federal level after January 2017, California and other states have signaled that they will go their own way.

In Colorado, more than one thousand two hundred thirty licensed grow facilities comprise almost half of new demand for power. In 2014, two years after residents voted to legalize cannabis for adult use, growing sites consumed as much power as thirty-five thousand households.

In California, the nation's oldest legal medical cannabis market, indoor production consumed nine percent of household electricity, the amount used in one million homes – eight years ago. This estimate was made before adult use was legalized in November 2016.

The District of Columbia and twenty-nine other jurisdictions have legalized cannabis in some capacity. One official says, "If that legalization continues, we're looking at a thirty-five billion a year industry, and a third of that is related to energy consumption." Some even envision a near term market of fifty billion annually.

The cannabis industry may become the most valuable U.S. crop and one of the nation's most energy-intensive industries. Cannabis facilities in the twenty-nine states where cannabis is legal are already responsible for greenhouse gas emissions that, statistics suggest, exceed those of New Hampshire.

Regulations cover everything from tracking individual plants to package labeling and advertising. But they generally lack requirements to reduce energy consumption or to address greenhouse gas emissions and environmental concerns.

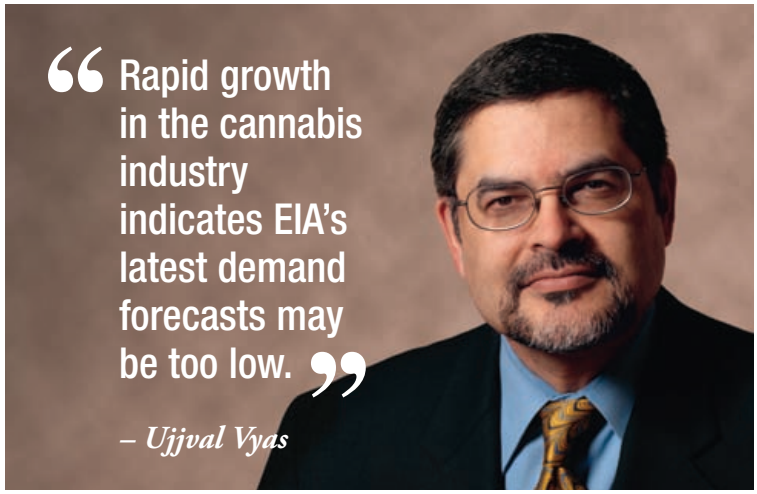
However, environmental lawyers are working hard to change this. Increases in fees, taxes, and surcharges create impediments to the legal cannabis industry and policy incumbency problems can make more rational long-term outcomes difficult.

The competing objectives of the cannabis businesses, environmentalists, regulatory agencies, governmental entities, and the public make it important to prevent policy capture by any one set of specialized interests.

Policymakers have thus far failed to address the cannabis industry's energy and climate impacts, an area of keen interest to many in states such as California, Colorado, Massachusetts, Oregon, and Washington where cannabis is legal.

Although cannabis is a plant, it is not a so-called green product when grown indoors. For example, Colorado has set a goal of generating thirty percent of its electricity from renewables by 2020, and some Colorado cities have established carbon neutrality goals.

Currently, however, only eighteen percent of Colorado's electricity comes from renewable sources, and the rest is generated from coal and natural gas. On-site generation systems such as rooftop solar arrays cannot produce nearly enough electricity to meet cannabis growers' energy needs.



As a result, the cannabis industry is increasing Colorado's carbon footprint and reliance on fossil fuels. That causes consternation among elected officials, environmentalists, and many of its green-oriented citizens.

Conclusions

The legal cannabis business is growing rapidly and its growth will continue to accelerate. The growth in cannabis production and its high energy use is causing electricity demand to increase rapidly and unexpectedly.

Cannabis production is extremely energy intensive and anticipated rapid growth in the cannabis industry indicates that EIA's latest U.S. electricity demand forecasts may be too low. Within thirty years, the U.S. may require between fifty and ninety gigawatts more electricity than EIA forecasts.

Legislative and regulatory actions for cannabis growers thus far have included renewable energy mandates, special rates, surcharges, upfront charges, and other actions. However, these are ad hoc stopgap measures and more comprehensive solutions and optimal policies must be developed.

Ideally, the policies should be in the best interests of utilities, regulators, the cannabis industry, cannabis consumers, and environmentalists. In addition, it is important to recognize that economic rationalization of the cannabis markets may lead to increased deployment of advanced technologies and the adoption of new technologies and processes.

The cannabis industry is well situated to become a leader in technology changes in energy and water usage resulting from the vast demand for its products and profit-making opportunities. This will be discussed in Part II in this series. PUF

Endnotes:

1. Evan Mills, "The Carbon Footprint of Indoor Cannabis Production," *Energy Policy*, Volume 46 (2012), pages 58–67.
   Mills estimated that cannabis production accounts for one percent of U.S. electricity consumption, and three percent in California. However, his study used data from 2009 and 2010 – prior to explosive cannabis legalization.
2. LBNL estimates that U.S. data centers consume about two percent of U.S. electricity. Lawrence Berkeley National Laboratory, "United States Data Center Energy Usage Report," LBNL-1005775, June 2016. Based on the most recent data, we estimate that in 2017 the cannabis industry will consume about three to six percent of U.S. electricity.
3. Walter Stark, "Addressing the High Cost of Energy," August 5, 2016. Marijuana Venture (website article).
4. Data from U.S. Energy Information Administration, *Annual Energy Outlook 2017, With Projections to 2050*, January 2017.
5. Tom Huddleston, "The Booming Pot Industry Is Draining the U.S. Energy Supply," *Washington Post*, December 21, 2015.

They're It

FERC Acting Chairman Cheryl LaFleur and Commissioner Colette Honorable. They're it. FERC may not have a quorum for months as we await the nomination by the President and confirmation by the Senate of three commissioners and designation by the President of a new chairman.