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Letter from the Editor

Welcome to the fifth volume of the BRG Review, the official publication of Berkeley Research Group, LLC. This issue provides insight into several topics based on independent analysis by our authors. The breadth of material covered provides a glimpse into the varied and interesting ongoing research performed around the world by experts and staff throughout BRG. Our experts comprise academics and private-sector professionals in many fields, including economics, finance, healthcare, and data analytics. Today, BRG has over 900 employees in more than 35 offices worldwide who analyze complex problems.

In our first paper, Aaron Vandervelde and JoAnna Younts provide an in-depth review of integrated community oncology practices, which have faced serious financial challenges in recent years. These practices provide personalized care for cancer patients in a way that reflects community preferences. Integrated community oncology practices have high customer satisfaction ratings and comparable outcomes to hospitals, all at lower costs. However, payments for similar services provided by hospitals are higher, creating pressure for hospitals to either absorb local integrated community oncology practices or develop or expand their own practices. Reductions in reimbursement for chemotherapy drugs, increasing regulatory complexities, and greater competition from hospitals (including due to access by hospitals to 340B program discounts) have also increased pressure on these private practices. As a result, hundreds of integrated community oncology practices, despite providing a high-quality product at reasonable cost, are closing or becoming absorbed by hospitals. Vandervelde and Younts document these changes in their original research, which includes survey work and analysis of Medicare data. One question to debate is the degree of harm to patients that may stem from changes in the integrated community oncology practice industry due to presumably unintended consequences of healthcare policies.

In our second paper, Jeff Armstrong, Ph.D., writes about recent trends in false advertising cases. Dr. Armstrong presents information on false and deceptive advertising claims going back to 2000, looking at actions brought by the FTC, class action lawsuits, and Lanham Act lawsuits. His data shows that while the number of Lanham Act claims has been relatively steady through time (with the exception of a dip in 2010 following the financial crisis, which also led to less money spent on advertising), FTC actions have been on the rise. He documents that the types of cases brought are not distributed evenly across industries. Cases in the leisure and hospitality industry, and in the business solutions industry, are much more often Lanham Act claims. Cases in the weight-loss and cosmetics industries, by contrast, have been generally brought by the FTC or by a class of consumers. Some industries (like food and beverage) show a mix of cases. Firms with strong brands are more likely to be a party to a Lanham Act lawsuit compared to firms responding to an FTC enforcement action. Dr. Armstrong also discusses implications of recent food and beverage sweetener ingredient trends for the *Western Sugar Cooperative et al. v. Archer Daniels Midland Co. et al.* case, which settled at trial in late 2015.

Finally, we have two papers written in response to a hypothetical question posed by BRG Review editors: What would be the total cost to satisfy U.S. electrical needs with solar power? Neil Shifrin addresses this question in part by using his own experience with a solar panel on his residence. He finds a cost of shifting immediately to be about $17 trillion, which is comparable to an entire year of GDP and many times the expenditures (in today's dollars) of the U.S. during World War II. Even so, he argues that we must confront our limited carbon future. Daniel Michel takes a somewhat different approach by developing a detailed model that looks at a pattern of installation and infrastructure costs between now and the year 2050. Michel estimates costs of about $5.6 trillion in today's dollars. The papers raise questions about the timing of the hypothetical transition, technological change, infrastructure requirements, and land use, and yet just scratch the surface of the topics that might arise from such a fundamental change in our electricity generation. A full assessment of the effects of such a change might include health benefits, changes to battery technologies that would undoubtedly emerge, and impacts from the retirement of existing generation facilities. Electricity pricing itself would be impacted substantially, as prices would not be determined by the highest operating costs at the margin, which today typically use fossil fuels (i.e., intermediate or peak-generation capacity), but instead might be driven by opportunity cost—that is, what power can be sold for at a different time of the day.

We hope these papers stimulate discussion and discourse and deepen our relationships with fellow professionals, academics, clients, government representatives, attorneys, and other interested individuals across the globe.

Regards,

Cleve B. Tyler, Ph.D.
Editor

A Detailed Diagnosis of Integrated Community Oncology[1]

Aaron Vandervelde and JoAnna Younts[*]

Executive Summary

Integrated community oncology practices are a cornerstone of cancer care in the United States. Serving a wide range of insured and uninsured people in both rural and urban settings, these practices do more than treat cancer patients. They manage the lives of cancer patients while addressing the myriad of social and health issues that come with fighting cancer. But despite the benefits, these integrated community oncology practices are not well understood and are vulnerable to economic pressures, regulatory frameworks, and hospital competition. Because of these challenges, over the last five years hundreds of community practices have closed, merged, or been acquired by hospitals and hospital systems.

In an effort to better inform policy makers and stakeholders in the fight against cancer, this study seeks to:

- Define the shared characteristics and unique aspects of integrated community oncology practices
- Highlight the benefits these community practices provide to cancer patients, payers, and the healthcare system generally
- Understand the challenges facing integrated community oncology practices and the impact these challenges have on the viability of this care delivery model

Through a combination of literature review, physician and administrator interviews, data analytics, and a survey of integrated community oncology practices, we have made a number of observations and drawn the following conclusions regarding these practices:

- Integrated community oncology practices share a number of common characteristics, including care coordination, patient-provider communication, and personal attention, but are uniquely shaped by the communities in which they operate.

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JoAnna Younts is a director in BRG's Health Analytics practice. She provides strategic advisory services and consulting support to providers and payers related to billing and coding, reimbursement policy, and payment systems.

1 Originally published in April 2015. JoAnna Younts and Aaron Vandervelde. *A Detailed Diagnosis of Integrated Community Oncology*. BRG and the Community Oncology Alliance white paper (April 24, 2015). Available at: http://www.thinkbrg.com/newsroom-publications-younts-vandervelde-oncology-coa.html

- Integrated community oncology practices provide access to cancer care at a lower cost than hospital outpatient departments.
- Integrated community oncology practices deliver state-of-the-art cancer care and are beginning to adopt innovative healthcare delivery and payment models.
- The challenges facing integrated community oncology practices include reduced reimbursement, complex regulations and reporting demands, and hospital competition that highlights significant payment disparity between the physician office and hospital outpatient settings.
- These challenges are both pushing and pulling integrated community oncology practices into higher-cost hospital outpatient departments.

This study was funded by the Community Oncology Alliance (COA).

Historical Background

Until the 1970s, cancer treatment focused primarily on surgery, with few drugs proven effective against the disease. As such, cancer care meant hospitalization, usually for long periods. As more drugs became available and chemotherapy became integral to cancer treatment, medical oncology as a specialty grew rapidly, but treatment remained in the inpatient setting. This changed dramatically in 1982 with the passage of the Federal Tax Equity and Fiscal Responsibility Act (TEFRA), which launched prospective payment for hospital inpatient services through Diagnosis Related Groups (DRGs). This created economic pressures that forced cancer care out of the inpatient setting and into outpatient settings. The outpatient setting proved to be more cost effective and, in many ways, more pleasant for patients, while also improving access to care for patients, particularly low-income and rural residents, who no longer had to travel long distances for cancer treatment.

The trend toward outpatient cancer care continued to accelerate as commercial payers also adopted DRGs and physicians began providing chemotherapy infusion in their offices. Although the Medicare Fee Schedule rates for chemotherapy administration were generally low, reimbursement for drugs under the Average Wholesale Price (AWP) formula provided enough drug-margin to cover the losses on chemotherapy administration and fund other unreimbursed ancillary services, such as patient financial counseling, social support, and nutritional counseling. By the 1990s, community-based oncology practices were flourishing across the United States, and patients had greater access to cancer treatment closer to home.[2]

However, this economic equilibrium was disrupted following passage of the 2003 Medicare Modernization Act (MMA). MMA regulations changed the reimbursement mechanism for drugs from AWP to Average Sales Price (ASP) plus 6%, which effectively eliminated drug margins after accounting for the costs of buying, storing, and handling the drugs. While these reductions forced practices to become more efficient, they also made it more difficult to cover costs, particularly

2 Dawn Halcombe, "The Evolution of Community Oncology Care and its Threatened Extinction Due to Federal and Private Payment Reform," American College of Medical Practice Executives (August 25, 2003).

the costs of unreimbursed ancillary and support services that had once been subsidized by drug reimbursement. In addition, there was risk associated with the high carrying costs of the drugs themselves. Some practices found that the financial pressures were too great or that they needed the economies of scale that larger groups and hospitals could provide. These practices closed, were acquired by hospitals, or merged with other practices. The prevailing community-based model that emerged from this upheaval in the marketplace is the integrated community oncology practice of today.

Todays Integrated Community Oncology Practice

The evolution in cancer care and reimbursement that gave rise to integrated community oncology practices has necessarily resulted in variations in the services provided and operational structure of these practices. This was evident in our interviews of oncologists and practice administrators, as well as in our survey of community oncology practices. Most interviewees pointed out that the concept of an integrated community oncology practice cannot be defined solely based on services provided directly by a practice, or even by the services provided directly *and* indirectly through arrangements with other practices, hospitals, or other providers. Instead, most said that the definition rests on a few key concepts, namely coordination, communication, and personalized care. Therefore, in attempting to define what an integrated community oncology practice actually is, this paper focuses on each individual term in the context of cancer care.

Our research suggests that integrated community oncology practices can be defined as providers of coordinated oncology care that are uniquely shaped by the communities in which they operate. As a result, no two practices are alike, and they often function differently in terms of the types of services provided, where they are provided, and how they are managed. Nevertheless, this model of coordinated care is underpinned by strong patient–provider communication and personal attention, and thus provides numerous advantages to patients, payers, and the healthcare system in general.

Integrated

Webster's dictionary defines *integrate* as "to form, coordinate, or blend into a functioning or unified whole."[3] Indeed, the words "coordinate," "coordinated," and "coordination" were repeated often by individuals interviewed. Care coordination can translate operationally in different ways—from all services provided under one roof to services provided in multiple locations but directed or otherwise managed by a practice. More than one interview respondent used a sports analogy to describe integrated cancer care. "Cancer care is a team sport," said one physician. Another added that the oncologist or a nurse navigator is like the "quarterback" who calls the plays and that the team (other physicians, midlevel practitioners, nurses, and staff) executes the plays.

3 "integrate." *Merriam-Webster.com*. (2015). Accessed April 12, 2015, at: http://www.merriam-webster.com/dictionary/integrate

Community

Interview respondents most often described "community" as the place where patients live and work. Communities, in turn, also influence what type of integrated oncology models will work there because they have differing regulatory, political, and economic environments. For example, in states with Certificate of Need (CON) laws, community practices can be restricted to medical oncology services, because local hospitals own radiation therapy and other large equipment-dependent services (requiring a CON). In other cases, the "community" has become an entire state or region. For example, over half of the oncology practices in one state in the northeast have joined in a network that includes an academic medical center and other facilities, and contracts with payers as a single entity. Some rural communities have embraced oncology practices in different ways, from remote cancer care outposts where residents can receive basic services to networks that include rural hospitals and other providers that offer more comprehensive services.

Oncology

In its purest clinical definition, oncology focuses on the medical aspects of cancer. In fact, the National Cancer Institute defines *oncology* as "[a] branch of medicine that specializes in the diagnosis and treatment of cancer." This definition includes medical oncology, radiation oncology, and surgical oncology. Yet, as cancer care has evolved from a mostly inpatient service to an outpatient and community-based service, the definition of oncology has become more holistic, encompassing not only clinical ancillary services such as lab testing and imaging, but also social and support services such as counseling, nutritional support, and pain management. Over 98% of survey respondents that consider their practice to be an integrated community oncology practice provide additional services beyond just medical, surgical, or radiation oncology.

Practice

Some community-based oncologists would describe their practices as "centers," almost functioning as hospital cancer centers in the way that they offer a wide range of services either under one roof or through closely connected locations and satellites. Others would describe their practices as doctors' offices, because they are smaller, have fewer physicians, and offer fewer services directly, but coordinate services provided by other entities. However, all of the practices interviewed emphasized the personalized nature of the services they provide in their practices, regardless of size or number of physicians.

Although the types of services provided by integrated community oncology practices are not what define them, the breadth and depth of services are quite impressive. In addition to medical oncology, hematology, and infusion services, which virtually all practices provide, 76% of surveyed practices conduct clinical research, 54% have a dispensing pharmacy, 42% provide imaging services, and almost 35% give radiation therapy. In addition, the services are not limited to just "medical" services, as 95% of practices provide financial counseling, 39% employ a social worker, 32% have a dietician on staff, and 23% provide psychological support. Figure 1 gives a more comprehensive picture of the many different ways in which integrated community oncology practices serve their patient population. Services with a larger font size had a higher percentage of survey respondents who reported providing them directly in their clinic. Services with smaller font sizes are less likely to be provided directly in the clinic but are coordinated by the integrated community oncology practice.

Figure 1

Common Misconceptions about Community-Based Oncology

Perception It is not possible for a patient to obtain all cancer services in a community-based practice. At some point, he/she will need to be referred to a hospital.

Fact *Many community-based practices interviewed provide all cancer services, from diagnosis through treatment to survivorship support.*

State-of-the-art cancer care is only available in hospitals.

The latest technologies and drugs are available in community practices as well as hospitals, and preliminary results of an ongoing study of utilization and quality measures suggest that community-based models actually perform better than hospitals on certain measures.[4]

Access to clinical trials is an option only at academic medical centers.

Over 75% of respondents to our survey reported availability of clinical research opportunities in their practices.

Integrated community oncology practices and hospitals are mutually exclusive.

Several practices interviewed have close relationships with hospitals: some rent space in hospitals and/or refer patients to hospitals for certain services, and others have PSAs with hospitals.

4 Maxine Fisher et.al. "Comparative health care (HC) costs and quality of care in five cancer types by physician office (PO) and hospital outpatient (HOP) settings." Poster highlights session presented at 2014 ASCO Annual Meeting (2014).

Benefits of the Integrated Community Oncology Practice

According to the literature, as well as physicians and administrators interviewed, the integrated community oncology model has numerous benefits that accrue to patients, payers, and the healthcare system in general. In addition to well-documented benefits such as lower costs and better access to highly personalized care, integrated community oncology practices are often more innovative in terms of care delivery and payment models. These innovations, coupled with the lower costs of community-based care, provide significant benefits to not only patients and payers but also the healthcare system as a whole.

Benefits to Patients

Our analysis suggests three primary benefits to patients of integrated community oncology practices:

1. Lower costs relative to hospital outpatient care
2. Efficient care delivery, particularly through medical home models
3. Personalized delivery of care

Lower Costs Relative to Hospital Outpatient Care

The most quantifiable benefit for patients, which has been demonstrated in multiple studies, is lower out-of-pocket costs for cancer treatment delivered in the community setting compared to hospitals. Because of the differences in reimbursement approaches and rates paid by Medicare between hospital and physician office settings, overall payments for oncology services are generally higher for hospitals compared to physician offices. For example, a 2011 study conducted by Milliman found that Medicare pays $6,500 more per year for chemotherapy for 10 common types of cancer when provided exclusively in a hospital setting than in a physician office. This higher Medicare reimbursement translates to an additional $650 in costs to Medicare beneficiaries, in the form of higher co-insurance.[5]

In a 2014 study, the IMS Institute for Healthcare Informatics found that for 10 common oncology drugs, the average cost to a patient was $134 higher per dose when administered in a hospital compared to a physician office. Furthermore, the authors noted that "multiple therapies may be given per treatment cycle when both combination and chemotherapy support drugs are considered, leading to significant increases in member financial burden."[6]

Perhaps the starkest difference in reimbursement rates comes from an analysis done by Lee Newcomer, MD, on UnitedHealthcare data. In a recent Health Affairs article, Newcomer notes that "medical oncologists in private practice are paid 22 percent more than Medicare rates for

5 Kate Fitch and Bruce Pyenson, *Site of Service Cost Differences for Medicare Patients Receiving Chemotherapy*, Milliman Client Report (October 19, 2011).

6 IMS Institute for Healthcare Informatics, "Innovation in cancer care and implications for health systems" (May 2014).

providing chemotherapy. However, hospitals that own oncology practices or employ medical oncologists can use their contracting leverage to earn reimbursement for the same service at an average of 146 percent more than Medicare… It is not right that cancer patients are bearing this heavier burden." The table below summarizes some of the key findings from these and other studies looking at the differences in reimbursement and out-of-pocket expenses for cancer therapy provided in a community oncology practice versus the hospital outpatient department.

Figure 2

KEY FINDINGS FROM PAYMENT PARITY STUDIES

Study Author	Time Period	Patient Population	Key Findings
IMS Health (May 2014)	2010-2012	Multiple Payer Types	The average cost for 10 routinely prescribed chemotherapy drugs is 189% higher on average in the hospital outpatient setting versus in a physician's office
Moran (August 2013)	2009-2011	Medicare FFS Patients	Chemotherapy spending per patient day ranged between 24.3% and 40.1% more in the hospital outpatient setting than physician offices
Jad Hayes, et al (April 2015)	2008-2010	Commercial Patients	When controlling for cancer type, geographic location, patient age, and number of chemotherapy sessions, patients seen in a community oncology clinic had a 20% to 39% lower mean per member per month cost of care than patients seen in a hospital outpatient department
Avalere (March 2012)	2008-2010	Commercial Patients	Chemotherapy treatment costs an average of 24% more when provided in a hospital outpatient department versus in a physician's office
Milliman (October 2011)	2006-2009	Medicare FFS Patients	Total healthcare costs for patients receiving chemotherapy exclusively in the hospital outpatient setting are 14.2% more expensive than for patients receiving treatment in the physician office setting

Efficient Care Delivery

As described previously, a key characteristic of the integrated community oncology practice is coordinated care, which typically results in greater efficiency. A Duke University study found that by one important measure of efficiency—the time from diagnosis to first chemotherapy treatment—the average number of days was shorter for patients seen in physician offices compared to in outpatient hospital settings.[7] Of respondents to our survey, 95% rated community-based practices as excellent or very good in providing coordinated care, compared to 28% who rated hospitals as very good or excellent in this area. Physicians and practice administrators interviewed who have worked in both community and hospital settings agreed, pointing out that there community practices often have less bureaucracy, allowing doctors and staff to interact more frequently.

7 Alisa Shea et al., "Association Between the Medicare Modernization Act of 2003 and Patient Wait Times and Travel Distance for Chemotherapy," *Journal of the American Medical Association* (July 9, 2008).

The manifestation of the coordinated care concept is often considered the "Patient Centered Medical Home" (PCMH). Dr. John Sprandio pioneered the Oncology PCMH in 1997 in Pennsylvania, and variations on the model have been implemented across the country. He describes these models as "...attempts to promote a value-based agenda that facilitates physician accountability, encourage clinical integration between likeminded medical oncology groups, enhance communication and coordination of care with primary care PCMH models, and collaborate with payers while maintaining a focus on patient needs and evidence-based care."[8]

In many ways, the medical home concept is a natural extension of the integrated community oncology model. Coordination and communication are critical to the definition of integrated community practices, as described previously, and the medical home model expands and enhances these aspects through formal processes. Some payers have also discovered the benefits of medical homes and are working with providers to leverage the concept in the development of bundled payments and shared savings programs. For example, the Medicare program funded a demonstration project called Community Oncology Medical Home (COME HOME) model, which has been implemented in seven community oncology practices around the country. The project builds on the concept of a PCMH, with goals to "improve health outcomes, enhance patient care experiences and significantly reduce costs of care." COME HOME is aggressively managing patients through specific care processes and pathways, and it estimates savings of up to $34 million to the Medicare program, or $4,178 per patient.[9]

CASE STUDY

Practice Name: Center for Cancer and Blood Disorders

Geographic Area: North Texas (Dallas/Fort Worth area)

Number of Physicians: 19 *Number of Mid-level Practitioners:* 5 *Number of Locations:* 9

Services Provided:

- Physician specialties: Medical oncology, radiation oncology, gynecologic oncology, and breast surgery
- Ancillary services: Imaging, biopsy-based surgical services, CyberKnife, social services, nutritional counseling, retail pharmacy, massage, acupuncture, chaplaincy, nurse navigation, and others

Overview

The Center for Cancer and Blood Disorders was formed by the merger of two oncology groups in the mid-1990s. The "central campus" in Fort Worth, Texas, provides comprehensive cancer treatment services in a single building, including medical oncology, infusion, radiation therapy, and other clinical services. The Careity Breast Center was recently opened in cooperation with Huguley Memorial Medical Center in Burleson, Texas, and provides state-of-the-art services for breast cancer patients.

The Center for Cancer and Blood Disorders' case management team and triage nurses provide additional infrastructure to enhance the integrated care model, and the practice also participates in the Medicare COME HOME medical home pilot project. The practice has been certified by the American Society of Clinical Oncology's (ASCO) Quality Oncology Practice Initiative (QOPI®) Certification Program, which recognizes adherence to specific quality-improvement process measures. Beyond innovation in the care delivery model, the Center has participated in several payment initiatives including an episode of care pilot project with UnitedHealthcare and a shared savings arrangement with Aetna.

Personalized Delivery of Care

With or without medical home models in place, another often-cited benefit of integrated community oncology practices is their personal, "high-touch" environment. Ninety-five percent (95%) of survey respondents rated patient–physician communication in community settings as

8 John Sprandio, "Oncology patient-centered medical home and accountable cancer care," *Community Oncology* 7:12 (December 2010).

9 John McCleery, "Innovative Cancer Care and the Initiation of the COME HOME Medical Home Program," OBR Green: *Health Information Exchanges* 7:11 (December 2013).

very good or excellent; only 30% rated patient–physician communication in hospitals as very good or excellent. Many of those interviewed emphasized that staff members working in community settings become very familiar with patients and their families and individual situations, which is not always possible in a hospital where staffs are larger and there are numerous shift changes. Others interviewed pointed out that cancer became less stigmatized when treatment moved out of the inpatient setting; in turn, patients realized not only that surviving cancer was possible, but also that it was possible to live with cancer *treatment* while still having a life.

Some community-based practitioners believe that community-based care further destigmatizes cancer because it allows patients to be treated in the communities where they live and work, minimizing the disruption to their lives. For patients needing end-of-life care and/or palliative care, most individuals we interviewed indicated that community practices offer a personal touch that is not always available in a hospital setting. This view is supported by other researchers on the topic. In an article in the *Journal of Pain and Symptom Management*, Dr. Arif Kamal, an oncologist and palliative care researcher at Duke University, reported that when determining palliative care needs, a "[c]ommunity-based assessment provides a more realistic depiction of caregiver roles and associated stressors, which may be invisible when the patient is hospitalized."[10] One physician interviewed, when asked about the difference in the patient experience between a community practice and a hospital, said, "It's like the difference between your shopping experiences at Walmart compared to a boutique dress shop. At a boutique dress shop, you'll meet the owner; they'll have a hand in your care. At Walmart, you're on your own."

95% *of survey respondents rated patient–physician communication in community settings as very good or excellent*

30% *of survey respondents rated patient–physician communication in hospitals as very good or excellent*

CASE STUDY

Practice Name: Dayton Physicians Network

Geographic Area: West/Central Ohio

Number of Physicians: 36 *Number of Mid-level Practitioners:* 7 *Number of Locations:* 18

Services Provided:

- Physician specialties: Medical oncology, radiation oncology, and urology.
- Ancillary services: Pathology, imaging, and pharmacy dispensing.
- Of the 18 locations, 6 provide comprehensive services. In addition to clinical cancer treatment, the practice also provides financial counseling, a palliative care program, and other support services.

Overview

The Dayton Physicians Network was formed through the merger of medical oncology, radiation oncology, and urology practices. The practice does not have a formal PSA with Premier Health, a six-hospital system in Ohio, but Dayton Physicians Network provides the majority of inpatient and outpatient cancer services for the health system and utilizes an electronic medical record (EMR) system. The practice has developed a formal medical home model and is one of seven practices participating in the Medicare COME HOME pilot project. The practice also has a medical home pilot project with Aetna. Initial data suggest that the medical home care delivery approach, which includes expanded office hours and other support services, has resulted in fewer emergency room visits, inpatient admissions, and duplicate testing for patients.

10 Arif Kamal, David Currow, Christine Ritchie, Janet Bull, and Amy Abernethy, "Community-Based Palliative Care: The Natural Evolution for Palliative Care Delivery in the U.S.," *Journal of Pain and Symptom Management* 46:2 (August 2013).

Benefits to Payers and the Healthcare System

While patients benefit from high-quality, highly personalized cancer care provided in community-based practices at lower cost, payers also benefit. Our research documents not only lower costs to payers but also innovation in care delivery models and reimbursement arrangements that may ultimately benefit the healthcare system.

Studies have documented different aspects of the cost savings that accrue to payers for cancer care services. A 2011 study by The Moran Company found that, "[b]y a variety of metrics, estimated chemotherapy spending is higher under the Hospital Outpatient Prospective Payment system (OPPS) than corresponding payments in the physician office under the Medicare Physician Fee Schedule (MPFS) for the same set of patients despite lower unit payment rates for drugs in the OPPS during the 2009-2011 period."[11] Moran researchers found that spending was substantially higher for Medicare claims paid under the OPPS than the MPFS for a variety of metrics, including spending per beneficiary, chemotherapy spending per day, chemotherapy administration spending per beneficiary, and chemotherapy drugs per patient per day. Our analysis indicates that the average per-claim expense for chemotherapy in the Medicare FFS population is $1,560 when delivered in a physician's office versus $2,064 when provided in a hospital outpatient department. This difference has actually increased over the last four years (Figure 3).

Figure 3

COMPARISON OF MEDICARE FFS REIMBURSEMENT AMOUNTS FOR CHEMOTHERAPY CLAIMS

YEAR	PHYSICIAN OFFICE SETTING	HOSPITAL OUTPATIENT	PERCENT HIGHER
2010	$1,436	$1,879	31%
2011	$1,570	$2,011	28%
2012	$1,606	$2,121	32%
2013	$1,643	$2,170	32%
AVERAGE	**$1,560**	**$2,064**	**32%**

Documented lower costs, coupled with adoption of more efficient care delivery models such as patient centered medical homes, can translate into increased value for the healthcare system. In fact, many individuals interviewed commented on the high value of integrated community oncology practices. Most felt that the clinical outcomes (such as survival rates) were no different between community and hospital settings, but that the value of services provided in the community is higher because the services cost less.

11 The Moran Company, *Cost Differences in Cancer Care Across Settings* (August 2013).

Eighty-three percent (83%) of survey respondents said that the value to Medicare and to commercial payers provided by community-based practices is "excellent." One physician interviewed summarized it: "We provide the highest quality care at the lowest cost."

Further benefitting payers and the healthcare system are the community oncology providers who are increasingly working together with payers to drive innovation focused on increasing the value of cancer care through bundled payments, shared savings, and other innovative payment approaches that move away from the traditional fee-for-service reimbursement model. Over 23% of respondents to our survey have implemented one or more of these payments models, and others are in active discussions with payers regarding these incentive arrangements. The results from these innovative payment models can be significant. UnitedHealthcare's Episode Payment Pilot Program included five practices that treated 810 patients with breast, colon, and lung cancer between October 2009 and December 2012 using episode payments (where a single episode payment was made based on average sales price for drugs and the existing fee schedule for other services). While the costs of chemotherapy drugs were $13 million higher than predicted, total costs were $33 million less than predicted—a 34% reduction in total costs.[12]

Challenges Facing Integrated Community Oncology Practices

Despite clear benefits of integrated community oncology practices, providers face challenges in the context of today's healthcare system. While the evolution of cancer care from the inpatient to outpatient setting resulted in a vibrant community-based oncology delivery system by the 1990s, the market began to change in the mid-2000s. Generally, the literature and interviews identified three broad challenges facing these providers:

1. Reductions in chemotherapy drug and administration reimbursement
2. Regulatory complexities
3. Competition from hospitals

12 Lee Newcomer, Bruce Gould, Ray Page, Sheila Donelan, and Monica Perkins, "Changing Physician Incentives for Affordable, Quality Cancer Care: Results of an Episode Payment Model," *Journal of Oncology Practice* (July 8, 2014).

Reductions in Reimbursement

Reductions in drug reimbursement that originated in 2003 with the MMA have created clear challenges for community-based oncology providers. However, many physicians interviewed said that while these reductions have been difficult to adjust to, they were not the primary challenge. The problem was that the decreases in drug reimbursement were meant to coincide with increases in reimbursement for other services, particularly chemotherapy administration, but adequate increases did not occur, leaving many practices without the necessary funds to cover their costs. In fact, Medicare reimbursement actually declined for several chemotherapy administration codes.[13] Over half of survey respondents (51%) cited reductions in Medicare reimbursement and 46% cited increases in practice costs as the biggest contributors to acquisitions of community-based practices and the resulting shifts in site of care for cancer treatment from physician offices to hospitals.

In 2013, sequestration, which amounted to about $1 trillion in automatic, across-the-board budget cuts for the U.S. economy, reduced drug reimbursement further from ASP plus 6% to ASP plus 4.3%. In addition, while the Patient Protection and Affordable Care Act (PPACA) has resulted in more individuals having health insurance coverage, some community-based providers find themselves shut out of insurers' narrow networks or forced to accept lower rates from health plans created to serve individuals who have purchased less-expensive health insurance products on exchanges. These and other financial pressures have "pushed" many smaller practices to join with larger practices or be acquired by hospitals. As ASCO reported in its 2014 "State of Cancer Care in America" report, "… smaller community practices handle a disproportionate share of patient care, particularly in the southern and western United States, yet are under far greater economic pressure than larger practices. Nearly two thirds of small practices (63%) reported that they were likely to merge, sell or close operations in the next year."[14]

"Practices are forced to misdirect their resources to comply with programs such as PQRS and Meaningful Use for no real gain for the patient or patient care."

Regulatory Complexities

Another often cited challenge for community-based providers is the increasingly complex regulatory environment. Healthcare providers in general are subject to numerous regulations surrounding patient safety and privacy, such as those found in the Health Insurance Portability and Accountability Act (HIPAA). Providers who treat Medicare patients must adhere to CMS provisions regarding treatment processes, quality measurement, electronic medical records, and claims processing, among other things. Some of these programs attach payment incentives and

13 Lola Butcher, "Unintended Consequences: How Government Policies Have Increased the Cost of Cancer Care – Part I: Medicare Pay Change Increased the Cost of Cancer Care," *The Oncology Times* (September 10, 2014).

14 ASCO, "The State of Cancer Care in America, 2014: A Report by the American Society of Clinical Oncology," *Journal of Oncology Practice* 10:2 (March 2014).

penalties, such as the "Meaningful Use" program, which is an initiative to ensure that electronic health records (EHRs) are used to improve quality of care; and Physician Quality Reporting System (PQRS), which uses a combination of incentive payments and negative payment adjustments to promote quality data reporting. Not surprisingly, 70% of survey respondents said that the costs of regulatory compliance were "very important" or "extremely important" relative to the ongoing viability of community-based practices. One physician said, "Practices are forced to misdirect their resources to comply with programs such as PQRS and Meaningful Use for no real gain for the patient or patient care."

The In-Office Ancillary Services (IOAS) exception to the Stark physician self-referral laws is also an important issue for integrated community oncology practices. The exception protects physicians from Stark violations when certain conditions regarding referred services are met. This has been an important protection for integrated community oncology practices that provide chemotherapy infusion, radiation therapy, and other services within their own practices. Critics of the exception say that it has been exploited by physicians for financial gain and has increased costs to the Medicare program. However, proponents for preserving the exception say that it promotes coordination of care and that ending it will actually increase costs to the healthcare system. In addition, its demise could accelerate the trend toward hospital acquisitions of integrated community oncology practices. Indeed, the Medicare Payment Advisory Commission has warned of potential "unintended consequences" of ending the exception and has advised against it. A 2014 Milliman study for the American Medical Association (AMA) found that annualized utilization and/or spending declined from 2007 to 2012 for certain ancillary services, such as advanced imaging, certain radiation therapy procedures, and pathology services provided in physician office settings, suggesting a shift in these services from community-based to hospital settings.

Other regulatory compliance activities are both time consuming and expensive. Providers of chemotherapy are subject to numerous drug-handling regulations, particularly those found in U.S. Pharmacopeia (USP) Chapter 797. Providers incur substantial costs in order to comply with special drug storage and staff training requirements. Some providers interviewed also said they have spent a great deal of time and money preparing for the conversion to ICD-10.One person interviewed described the regulatory environment as "oppressive," going on to say, "[a]s a community practice I don't have a plethora of people who can sit around and read the Federal Register all day or CMS's never-ending list of regulations." Many integrated community oncology practices have found themselves feeling "pulled" into hospitals in order to offload these administrative and regulatory burdens and rediscover the freedom to focus on providing patient care.

In addition to regulations that present compliance burdens, other regulations such as CON laws can burden practices by constraining expansion and integration of services. Thirty-six (36) states have CON laws, including 18 that have restrictions regarding magnetic resonance imaging (MRI) and 23 with restrictions on radiation therapy. While these laws were designed to control healthcare spending, some studies have shown that they can reduce competition and actually increase costs.

One practice interview cited CON laws as a barrier to integration. CON requirements in that state have prevented the practice from purchasing radiation therapy equipment, thereby forcing it to refer patients to local hospitals for these services. Advocates for less-restrictive CON laws have suggested alternatives to control utilization and costs, including payment reform and increased transparency regarding the costs of services. With respect to specific services such as imaging, one promising approach is patient centered medical homes, which can increase coordination of care and reduce unnecessary services. In one study, medical home models were shown to reduce imaging utilization.

Hospital Competition

While community oncologists face financial and regulatory challenges that both push and pull them into the hospital setting, this consolidation exacerbates the third broad challenge facing integrated community oncology practices: hospital competition. This competition has come from three fronts:

- Employment of oncologists and/or acquisition of community oncology practices to compete with other community-based practices
- Control of referral networks
- 340B drug pricing available to qualified hospitals

Some physicians and practice administrators we interviewed described being pressured by local hospitals to be acquired. When the practices refused, the hospitals hired their own oncologists or acquired other practices. This scenario has played out across the United States and has been accelerated by PPACA, which encourages movement away from fee-for-service reimbursement toward accountable care organizations (ACOs) and bundled payment arrangements that reward quality and efficiency. These types of arrangements are easier to implement for hospitals that employ or otherwise integrate physicians into their business models. In its fifth annual Community Oncology Practice Impact Report, COA reported a 143% increase in consolidation of community practices into hospitals since the first report in 2010. Since 2006, 544 community cancer practices have been acquired by or affiliated with hospitals. Nearly a quarter of respondents (23%) to our survey indicated that they are currently in serious discussions with a hospital regarding an acquisition. The most important reasons cited for doing so were: financial stress (i.e., reimbursement is not enough to cover costs; 62%), enhanced ability to compete in the marketplace (43%), improved negotiating power with commercial payers (33%), and greater access to referrals (24%).

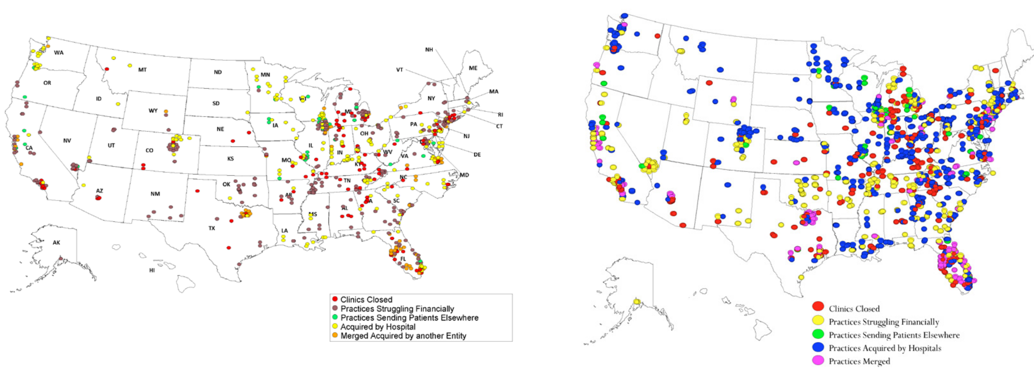
The issue of referrals was frequently mentioned in interviews as well. Individuals described declining referrals from primary care and other physician specialties as hospitals have acquired these practices and in turn redirected referrals to their facilities. A recent article in *Modern Healthcare* described a “physician buying spree,” in which:

> [s]ystems across the country have been rapidly buying physician groups to expand their referral networks and prepare for a not-too-distant future where they will have to manage the health of their patient populations and be held financially accountable for meeting cost and outcomes goals. The hope is that stronger physician alignment will leave systems better positioned to meet the demands of payers, particularly as more health plans move to narrow networks.[15]

However, some community-based providers have expressed concern that this level of alignment will continue to "push" community-providers to either consolidate or close, and that will ultimately mean higher costs. One physician said, "[I]f the hospitals keep eating up the community based practices, then there will be no competition left. Competition keeps costs down."

Figure 4

Community Oncology Cancer Care Impact Map **2010** | Community Oncology Practice Impact Report **2014**



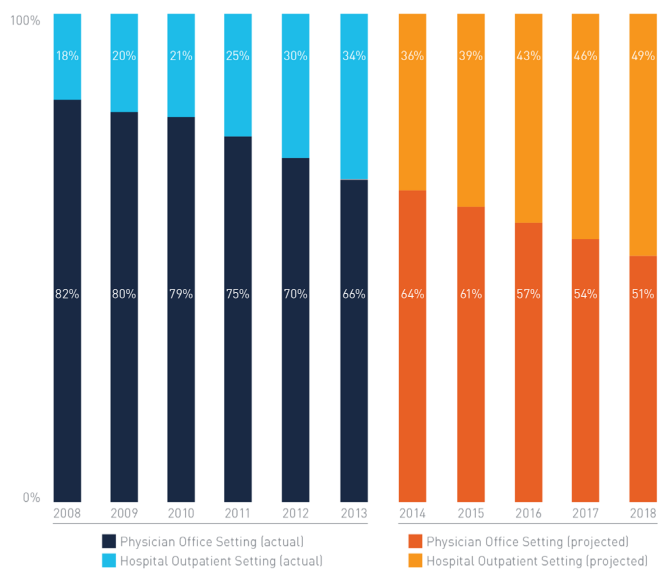
Perhaps the biggest source of concern regarding competition from hospitals is the access to 340B program discounts available to certain facilities, primarily hospitals that are eligible for Disproportionate Share (DSH) payments from the federal government. In fact, 65% of survey respondents cited 340B discounts as the biggest contributor to shifts in site of care for cancer treatment. According to a recent MedPAC study, over 2,100 hospitals currently participate in the 340B program (up from 535 in 2005), and 340B hospitals accounted for 46% of Medicare Part B drug reimbursement to hospitals.[16] Furthermore, DSH hospital participation in the 340B program is expected to grow over the next three to five years as Medicaid expansion results in hospitals becoming newly eligible for the program. Our research indicates that as many as 350 hospitals may become newly eligible for the 340B program due to Medicaid expansion.

15 Beth Kutcher, "Making physicians pay off: Hospitals struggle to balance current costs with future benefits of employing docs," *Modern Healthcare* (February 22, 2014).

16 Ariel Winter and Daniel Zabinski, "The 340B Drug Pricing Program," Medicare Payment Advisory Commission (November 6, 2014).

In addition to growth in DSH-eligible hospitals, Congress has extended 340B benefits to a variety of other types of hospitals.[17] Community-based practices, on the other hand, do not have access to these discounts, unless they are owned by hospitals, and hospitals can leverage their discounts by bringing on additional patient volume through practice acquisitions. An article in *Oncology Times* in the fall of 2014 said that "…hospitals with 340B pricing are lapping up cash-strapped physician-owned oncology practices, which are not eligible for the discounted prices. This propels the migration of cancer care to hospital outpatient departments…"[18] Indeed, Berkeley Research Group has documented this shift over the last five years and projects that the trend will continue for the next five years.

Figure 5



Most individuals interviewed commented that 340B discounts give hospitals an unfair competitive advantage. It "gives them a big leg up," said one physician. Many physicians we interviewed expressed frustration that the program has become misguided and misused. As one physician noted, "340B is a great idea. It allows patients to be treated who otherwise would not be able to afford it. But it should be patient-centric. The benefits of 340B should follow the patient wherever they are treated. It should not serve as a profit center to finance other divisions of a hospital that are otherwise failing."

"340B is a great idea. It allows patients to be treated who otherwise would not be able to afford it. But it should be patient-centric. The benefits of 340B should follow the patient wherever they are treated. It should not serve as a profit center to finance other divisions of a hospital that are otherwise failing."

17 Victoria Stern, "340B: Helping Patients or Enriching Hospitals?" *Clinical Oncology News* (October 2013).

18 Lola Butcher, "Unintended Consequences: How Government Policies Have Increased the Cost of Cancer Care – Part II: 340B Drug Discounts Have Fueled the Migration of Cancer Care," *The Oncology Times* (September 25, 2014).

Conclusion

Integrated community oncology practices are a cornerstone of cancer care in the United States. These practices provide efficient, quality cancer care to patients in their community at a cost that is lower to both the patient and payers, including Medicare. In fact, integrated community oncology practices provide a range of benefits to patients and the healthcare system, including:

- Integrating and coordinating traditional cancer care, such as chemotherapy, radiation therapy, and imaging, as well as ancillary services, such as patient financial counseling, social support, and nutritional counseling
- Staying on the cutting edge of innovations in the fight against cancer, including participation in clinical trials and cancer care models like oncology medical homes
- Adopting payment reform models, including medical oncology homes, bundled payments, and shared savings models
- Delivering high-quality care at a cost that is demonstrably lower than hospital outpatient-based care

Yet, despite the benefits integrated community oncology practices provide to patients, payers, and the healthcare system in general, these practices are vulnerable to challenges including:

- Cost of complying with increasingly complex government regulations from CON laws, USP 797 regulations, Stark laws, and programs like PQRS
- Reduced reimbursement due to changes in Medicare drug reimbursement, sequestration, and the changing landscape of private insurance attributable to PPACA
- Increased competition from hospitals, particularly those that benefit from access to lower drug prices through the 340B program

These challenges place additional strain on integrated community oncology practices. Not surprisingly, this is resulting in closures, mergers, or hospital acquisitions of integrated community oncology practices. Over 22% of the practices surveyed indicated they have signed a non-disclosure agreement with a hospital and are in active discussions regarding a hospital acquisition that will lead directly to an increased shift in site of care from the less expensive physician office setting to the more expensive hospital outpatient setting. Our analysis estimates that as much as 50% of all chemotherapy administration in the Medicare FFS population will occur in the hospital outpatient setting by 2018. If these trends continue, our research suggests a very different cancer care landscape marked by decreased access, less personalized care, and higher costs.

Appendix A: Data Sets Relied Upon

In order to conduct the analyses presented in this report, we used the following data sets:

Medicare Outpatient Research Identifiable Files (RIF) for 2008 to 2013: These data sets provide 100% of Medicare fee-for-service claims submitted by institutional outpatient providers. These data sets were used to:

- Identify total Medicare Hospital Outpatient chemotherapy claims over time
- Calculate the Medicare payments and Medicare Beneficiary payments on claims provided in hospital outpatient departments at the claim level

Medicare Carrier Limited Data Sets (LDS) for 2008 to 2013: These data sets are also known as the Medicare 5% Carrier Files or the Physician/Supplier Part B Claims Files. They contain a 5% sample of fee-for-service claims submitted on a CMS-1500 claim form, primarily by non-institutional providers. These data sets were used to:

- Identify total physician office chemotherapy claims over time
- Calculate the Medicare payments and Medicare Beneficiary payments on chemotherapy claims provided in physician offices at the encounter level

Appendix B: Methodology

This section describes in more detail the methodology used to conduct the analyses presented in this report. Specific topics include:

- Definition of chemotherapy claims
- Calculation of chemotherapy claim costs
- Re-pricing of physician office chemotherapy encounters

Definition of Chemotherapy Claims

For purposes of this study, we defined chemotherapy claims within the Medicare Outpatient RIF as claims with bill type 131 (interim and adjusted claims excluded) with chemotherapy administration codes and a diagnosis of cancer. Chemotherapy claims in the 5% Medicare Carrier File were also identified by the presence of a chemotherapy administration code and a diagnosis of cancer. Chemotherapy administration codes include therapeutic infusions of chemotherapy drugs and other IV hydration infusions in the CPT code range 96360–96549.

A diagnosis of cancer includes both primary and secondary ICD-9 diagnosis codes in the following ranges:

Figure 6

CANCER RELATED DIAGNOSIS CODES	
Description	**ICD-9 Diagnosis Codes**
Cancer	140-239
Thrombocytopenia	287.30, 287.31, 287.39, 287.49
Neutropenia	288.00, 288.02, 288.03, 288.09
Lymphadenitis	289.1, 289.2, 289.3, 289.53, 289.83, 289.89
Encounter for chemotherapy	V07.2, V07.39, V58.11, V58.12
Personal History of Cancer	V10.00-V10.91

Shift in Site of Care

In order to estimate the extent to which chemotherapy is shifting from the physician office setting to the outpatient hospital setting, we calculated the distinct number of chemotherapy claims (as defined above) occurring in each year within the physician carrier file versus the hospital outpatient file (physician claims totals were multiplied by 20 to account for the fact that the file represents a 5% sample). The process was performed for the years from 2008 to 2013 for which data are available. We performed a standard regression (using time as the independent variable) in order to project the results into future years and develop a line of best fit for the trend in shift of site of care in recent years. The intercept and coefficient generated by this regression were used to estimate the breakdown in site of care for the years from 2014 to 2018.

Calculation of Chemotherapy Claim Costs

This study evaluates the cost of chemotherapy claims to two different payers: the Medicare program and Medicare beneficiaries, including payments by third-party payers (e.g., Medigap insurance). The cost to the Medicare program is the Medicare reimbursement amount on the claim. The cost to Medicare beneficiaries includes deductibles, coinsurance and copayments, and payments made by the Medicare beneficiary's third-party insurance.

Re-pricing of Physician Office Chemotherapy Encounters

Both hospitals and physician offices often provide additional services to patients in support of chemotherapy treatment (saline used in chemotherapy infusions, imaging, pathology, etc.). To account for the additional costs associated with these services in the hospital setting, we combined reimbursement amounts for claims coded with at least one chemotherapy CPT code. For purposes of this study, chemotherapy claims coded with radiation administration CPT codes were excluded. Additionally, chemotherapy claims with $0 total allowed amounts were excluded from our analysis.

Within the physician office setting, multiple claims may be billed for different services provided during the same encounter (defined here as a distinct patient and date-of-service combination). To account for the cost of supporting services in the physician office setting, we combined reimbursement amounts for all encounters billed on the same date of service as encounters when a patient received at least one chemotherapy CPT code. For purposes of this study, encounters coded with both chemotherapy *and* radiation administration CPT codes were excluded.

We calculated total encounters, reimbursement amount, and average encounter cost for chemotherapy administration encounters within the 5% Medicare Carrier File. We then re-priced these encounters by multiplying the number of total physician encounters by the average reimbursement amount per claim from the Medicare Outpatient RIF.

Not all charges associated with a given physician office chemotherapy encounter will be paid to the physician's practice. For example, a physician may order an imaging study on a chemotherapy patient but not own the necessary imaging equipment. The imaging procedure itself may occur in a hospital outpatient department, which will collect reimbursement for the technical component of the service. The physician will collect only the professional component for interpreting the results. Because our re-pricing analysis is meant to capture all reimbursement to *physician offices* in support of chemotherapy treatment, the average encounter allowed amounts calculated for physician offices will not include the cost of supporting services billed by a hospital. This may decrease the average reimbursement for chemotherapy claims in the physician office setting.

Similarly, physicians may bill separately for their services when providing services in hospital outpatient departments to patients receiving chemotherapy in the hospital. Again, because our re-pricing analysis is meant to capture all reimbursement to *hospitals* in support of chemotherapy treatment, the average encounter allowed amounts calculated for hospital outpatient departments will not include physicians' services billed separately. This may decrease the average reimbursement for chemotherapy claims in the hospital outpatient setting.

Protecting the Pillars of Consumer Demand: False Advertising Cases and Economic Trends in the United States since the Financial Crisis

Jeffrey Armstrong, Ph.D.[*]

Abstract

This article discusses trends in false and deceptive advertising cases in the United States from 2000 to 2014. Analysis of multiyear trends and products covered in various dispute venues—FTC deceptive advertising actions, Lanham Act false advertising lawsuits, and consumer class action suits—reveals patterns such as the way advertising affects filing activity or how product characteristics influence disputes. False advertising litigation also varies over time in response to economic conditions and industry trends. A recent Lanham Act false advertising lawsuit involving companies that manufacturer sweeteners—*Western Sugar Cooperative et al. v. Archer Daniels Midland Co. et al.*—helps demonstrate the value of analyzing these trends to prepare for arguments and damages claims involving products where advertisements or labels about food and beverage ingredients are disputed by parties.

Introduction

False and deceptive advertising cases in the United States have been on the rise in recent years. Many cases involve allegations of false, misleading, or deceptive advertising for consumer goods brought by the Federal Trade Commission (FTC), by consumer class actions, or by businesses under the Lanham Act. This article examines trends in false or deceptive advertising lawsuits.

Each year, hundreds of billions of dollars in advertising influence consumer retail purchases.[1] And while buying patterns are complex, from an economist's point of view consumer purchase behavior is often guided by three basic "pillars" of consumer demand: the prices of products; income available to spend at the store (or online); and the brands that guide consumers to purchase (and repeat purchase) the products they prefer (or avoid the ones they dislike). Deceptive advertising can potentially distort these pillars and undermine the gains to consumers and/or businesses in the marketplace.

Just as sales and advertising vary over the business cycle, false advertising litigation varies over time in response to economic conditions and industry trends. This is true for FTC deceptive

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* Jeffrey Armstrong has broad experience in false and deceptive advertising matters and regularly writes about methods for estimating advertising impacts and damages. Dr. Armstrong has a Ph.D. in economics and has been working in the litigation area for over 15 years.

1 In 2014, advertising in the United States through major media channels exceeded $160 billion (see PricewaterhouseCoopers, *IAB internet advertising revenue report 2014 full year results* (April 2015), p. 20).

advertising actions, Lanham Act lawsuits, and consumer class actions. For example, the annual number of Lanham Act false advertising cases peaked shortly before the 2008 financial crisis and recovered unevenly, mirroring the economic uncertainty businesses faced after the crisis. In addition, product characteristics tend to vary across the different venues, reflecting in part the way businesses reach potential consumers through advertising.

Another emerging trend relevant to case activity has been the dramatic shift in advertising and retailing technology: the Internet has quickly become one of the key sources of advertising spend, reaching about $50 billion last year.[2] This has sparked the commercialization of "big data," which offers new information platforms and ways to reach consumers. In false or deceptive advertising cases, the connection between the challenged advertising and the consumers' actual buying behavior helps demonstrate causation and damages. "Big data" offers a potentially new way to scientifically test these connections. In Section 2, we present an example using Google Analytics to track consumer exposure to an advertising campaign.

Hundreds of individual cases underlie the long-term trends in false advertising litigation presented in Section 3. Section 4 discusses one of the few Lanham Act lawsuits that has gone to trial. In *Western Sugar Cooperative et al. v. Archer Daniels Midland Co. et al.*, a group of sugar producer plaintiffs alleged that a multiyear, multimedia advertising campaign swayed consumers to purchase food and beverage products sweetened by high fructose corn syrup (HFCS) instead of sugar.[3] The challenged advertising aired over television, print, and websites, and although specifics cannot be discussed here, these advertising avenues suggest an important role for big data, as described below. Additionally, the analysis of industry cost and retail price trends can help understand how consumers were potentially affected in these types of product ingredient cases.

Recent Advances in Evaluating False Advertising Effects Using Big Data

Before discussing trends in false advertising lawsuits, it is helpful to step back and examine one way information technology has advanced outside of litigation that could be potentially useful in these disputes. When the challenged advertisements have targeted consumers, as is typical in such cases, it is essential to know the universe of consumers exposed to the alleged false advertising, as well as how, when, and where consumers were reached. Information about consumers' awareness or potential reaction to the challenged advertising often comes from information gathered long after the advertising was aired, such as consumer surveys. Such data, while useful, may not be contemporaneous with the airing of the challenged advertisements. Thus, the data may be limited in terms of analyzing the actual purchases made by consumers during the period when the challenged advertisements aired.

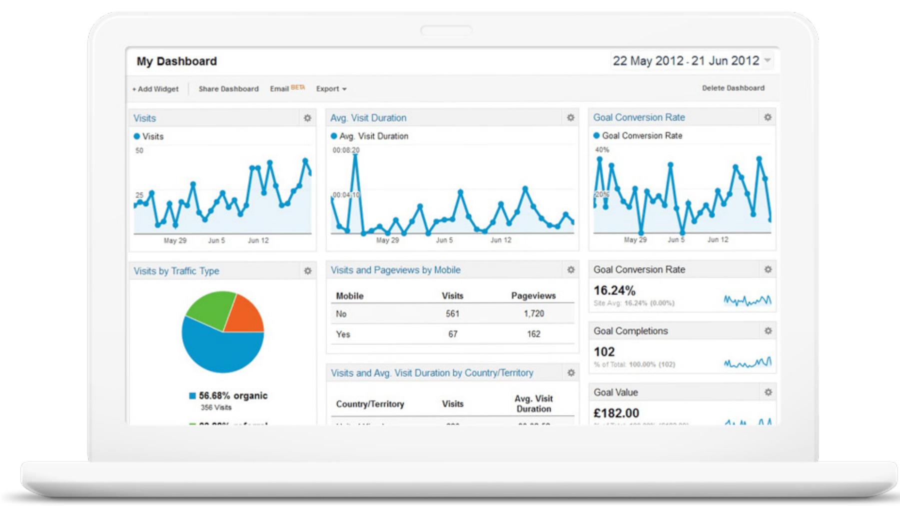
2 Id.

3 The author provided consulting support to counsel for the Defendants by reviewing the opinions of Plaintiffs' damages experts.

Information about current consumer activity is abundantly available in "big data" but can also be obtained on a historical basis through such tools as Google Analytics. Google Analytics tracks website visit activity in a number of metrics (e.g., first-time visits, visits from different areas of the country, pages viewed, and date and time of the visit session).[4] An example screen capture is shown in Figure 1.

Imagine consumers being exposed to an alleged false advertising campaign that aired on television, print, or the Internet. Figure 1 shows how consumer exposure to the Internet advertising campaign can be tracked through visits to a particular website. As part of an advertising campaign, consumers often are directed to specific pages on websites. The data compiled on the website visits, the pages visited, and where and when this occurred contain rich historical details about what consumers may have learned and reacted to in the alleged false statements. This approach to evaluating advertising impacts in a non-litigation context has proven effective and is regularly carried out by advertisers.[5]

Figure 1: Example of Google Analytics Website Tracking Data



Source: Google.com

Trends in False, Misleading, and Deceptive Advertising Lawsuits by the FTC, in Consumer Class Actions, and under the Lanham Act

This section summarizes the number of false or deceptive advertising lawsuits brought over time and across industries. The trends demonstrate material variation over time, across dispute venues, and by product categories, which suggests interesting connections between advertising, economics, and litigation activity.

4 See Sebastian Tonkin, Caleb Whitmore, and Justin Cutroni, *Performance Marketing with Google Analytics*, Wiley Publishing (2010).

5 For a discussion and example of this type of analysis, see Jeff S. Armstrong, "The voice of the consumer in the courtroom: how 'big data' can improve injury evidence in Lanham Act false advertising cases," *The Antitrust Source* (April 2015).

The charts discussed below are based on several sources: FTC cases are from its website;[6] consumer class action data is available in a presentation prepared by a law firm with specializations in intellectual property and is presented in summary form by industry;[7] Lanham Act lawsuit activity is assembled from various sources;[8] and advertising expenditure statistics are from *AdAge*.[9]

False and Deceptive Advertising Lawsuits over the Past 15 Years

Chart 1: Trends in False or Deceptive Advertising Litigation by Year

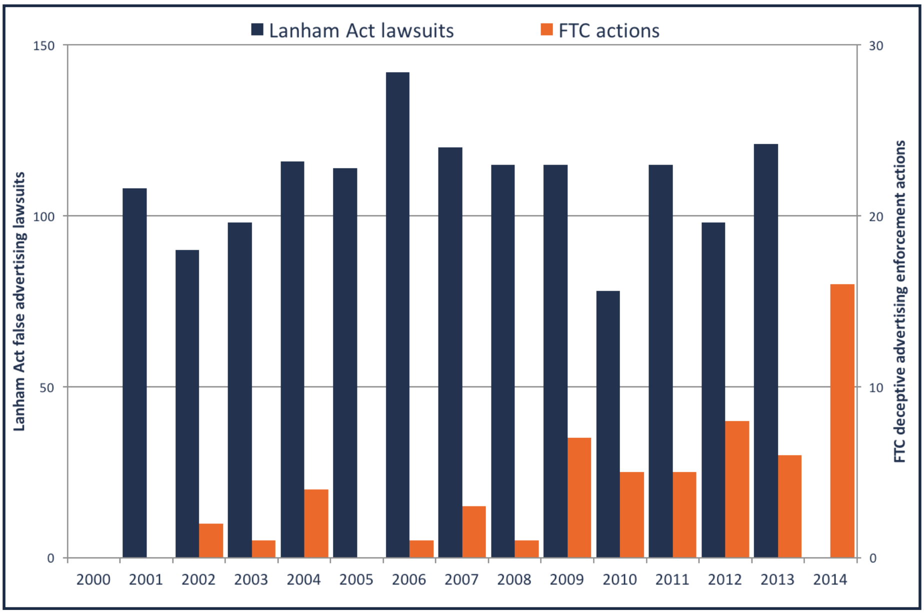


Chart 1 shows annual variation in the total number of false or deceptive advertising cases filed from 2001 to 2014.[10] The total number of lawsuits has varied over time, and there has been a substantial difference in the total number of cases filed by the FTC compared to businesses under the Lanham Act.[11] Lanham Act false advertising cases generally exceeded 100 each year, whereas in some years

6 Advertising enforcement actions were from the FTC's "Cases and proceedings" webpage by selecting "Consumer Protection" cases under "Advertising and Marketing." See https://www.ftc.gov/enforcement/cases-proceedings/advanced-search

7 Data on consumer class actions by product category was contained in a May 2015 presentation from Winston-Strawn, "Attention Food & Beverage Industry: False Advertising, Product Liability, and Defamation Litigation Is Making an Impact." See http://www.winston.com/en/thought-leadership/attention-food-beverage-industry-false-advertising-product.html

8 Data on the total number of Lanham Act cases is from "False advertising litigation in the United States," presented to the International forum for Consumer Protection by Christopher Cole of Crowell & Moring LLP. Data on product categories for Lanham Act cases is based on analysis of the lawsuits reported in Brian M. Daniel and John G. Froemming, "Trademark, false advertising and unfair competition cases: the Lanham Act and beyond" chapter 7 in *Calculating and Proving Damages*, Law Journal Press (2014 edition).

9 Advertising-to-sales ratios in 2010 are available at the four-digit SIC level from the website of *AdAge*. See http://adage.com/article/datacenter-advertising-spending/advertising-sales-ratios-2010/144639/

10 Lanham Act false advertising totals were not available for 2000 and 2014.

11 The Lanham Act allows businesses to bring false or misleading advertising lawsuits against competitors in federal court. Lawsuits typically allege the advertising targeted consumers, although a fraction of cases involve business-to-business advertising (see Randall K. Miller, "Lanham Act liability for promotional statements to distributors and other business customers," *The Antitrust Source* (October 2011)).

the number of FTC actions was 0. This was true before 2006. However, after 2008, the number of FTC actions shifted upward and reached an all-time high of 16 in 2014. Some reasons behind these trends appear to be related to the overall economy and to differences in the characteristics of products targeted by the challenged advertising.

Over this time frame, the United States experienced two major economic downturns, which impacted litigation activity. In 2000, the dot-com crash led to very large declines in equity prices that coincided with an economic recession in 2001. As can be seen from Chart 1, the number of Lanham Act false advertising lawsuits fell between 2001 and 2002, followed by a gradual increase, until reaching a peak in 2006. Some of the trend in cases is likely due to the recovering economy, but other factors could include the fast-growing use of the Internet to market trademarks and advertise products. For example, just prior to the dot-com crash, the Lanham Act was amended to include Internet domain name infringement or "cybersquatting."[12]

When the financial crisis began in 2008, there was again a slowdown in Lanham Act cases, which fully set in by 2010.[13] As opposed to the dot-com crash, the entire legal service sector fell as measured by output, bottoming out in 2010.[14] The sharp decline in Lanham Act cases was the result of a multi-prong shock: a broad economic decline that penetrated the legal sector and a decline in advertising expenditures, as discussed below.

By contrast, FTC deceptive advertising enforcement actions appear to be far less sensitive to the state of the economy. Indeed, focusing on the post-2008 period, the number of actions appears to be countercyclical or potentially due to noneconomic factors, such as the 2008 election. By 2014, the total number of FTC enforcement actions, 16, was four times higher than the preexisting average of 3.5 per year. This upturn in enforcement activity reflects in part an interest in specific categories of products identified in the FTC's enforcement guidelines.[15]

Turning back to Lanham Act false advertising cases, Chart 2 overlays an index of annual U.S. advertising expenditures on Chart 1.[16] First, advertising expenditures did not bottom out until 2009, one year before the low point in Lanham Act lawsuits. Second, advertising activity fluctuated after the financial crisis, dropping in 2012, as did the number of Lanham Act cases in that year. The level of Lanham Act cases coincides with commercial activity, and this is seen even more sharply when grouping cases by product categories.[17]

12 The Anticybersquatting Consumer Protection Act was enacted in 1999.

13 The parties to a Lanham Act case are competitors. Consumers are not permitted to bring Lanham Act lawsuits. However, competitors typically allege injury from false or misleading advertising that targeted their consumer base. Thus, questions of materiality and damages are addressed through the analysis of consumers' responses to the challenged advertising.

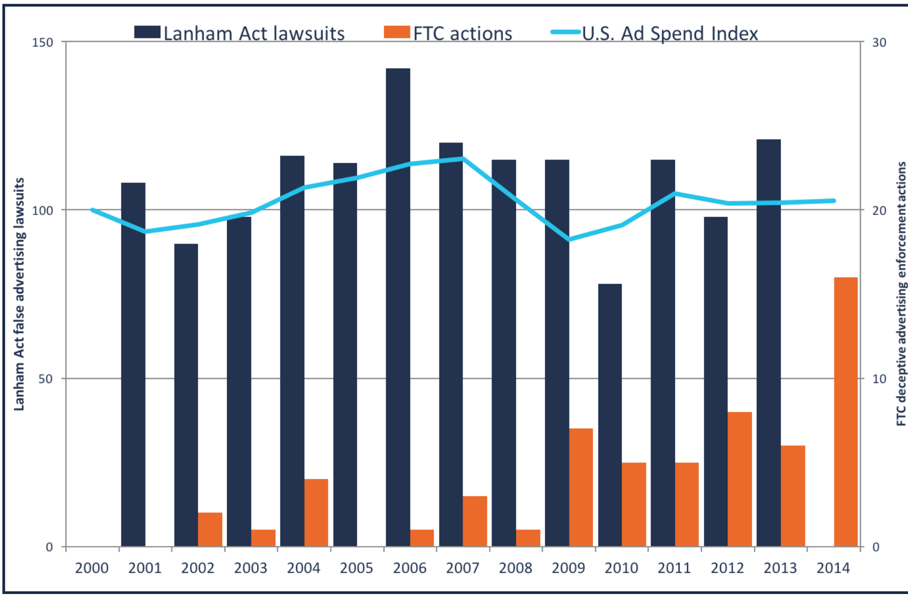
14 Bureau of Economic Analysis, annual "GDP-by-Industry data," available at: http://www.bea.gov/industry/gdpbyind_data.htm

15 The FTC guidelines specifically call out certain product categories and segments of the population where consumers are possibly more susceptible to deception, such as terminally ill individuals in search of treatment and dieters searching for an easier path to achieve weight-loss (Federal Trade Commission, *FTC Policy Statement on Deception* (October 14, 1983)).

16 The index base is 100, which is not shown on the table in order to display the pattern in the trend over time.

17 Several recent U.S. Supreme Court decisions on Lanham Act false advertising cases could affect lawsuit activity going forward, such as higher standards for demonstrating irreparable harm to obtain an injunction and the extension of the Lanham Act to cover food- and beverage-ingredient and health-related claims. See *Winter v. National Resources Defense Council, Inc.*, 555 U.S. 7,20 (2008); and *POM Wonderful v. Coca-Cola Co.*, 134 U.S. 2228 (2014).

Chart 2: Trends in False or Deceptive Advertising Litigation and U.S. Advertising Expenditures by Year



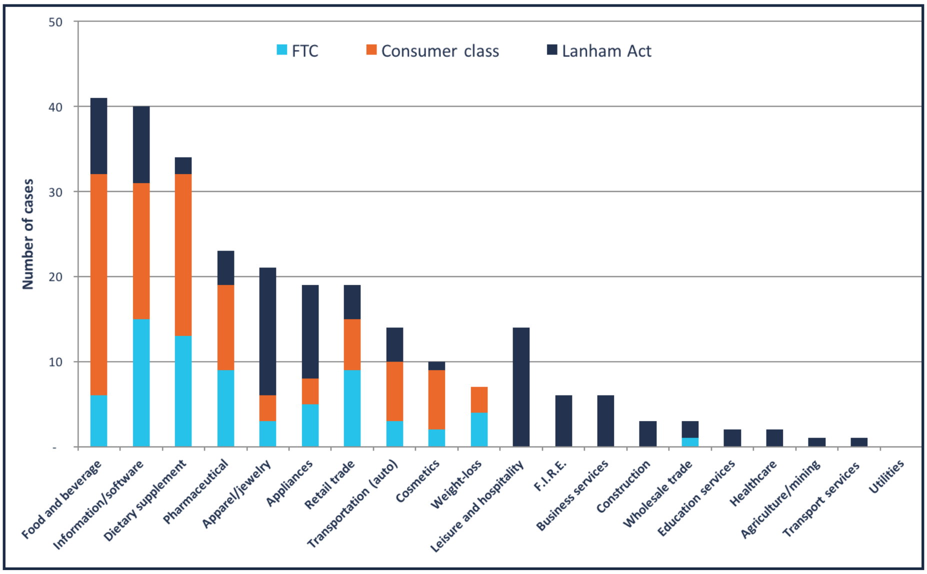
False and Deceptive Advertising Lawsuits by Product Category

The analysis of false or deceptive advertising lawsuits by product category presents another picture of how case activity varies across the three types of cases: FTC, Lanham Act, and consumer class actions. Product categories were based on descriptions of the companies and products involved in the litigation from public sources.[18]

It is clear that litigation activity on the whole tends to be concentrated in consumer product categories. However, it is interesting that some categories contain a very uneven distribution of the three types of lawsuits. Chart 3 shows the distribution of cases across the three case types by product category. The largest category is "food and beverages," followed by "information/software" and "dietary supplement." The category "information/software" comprises products that embody copyrighted material. The smallest category that contains all three case types is "cosmetics." The three types of lawsuits are unevenly distributed over these product categories. For example, there are no consumer classes or FTC actions in "leisure and hospitality," and the same is true for most of the categories on the right-hand side of the chart. By contrast, Lanham Act lawsuits constitute most of the cases in the "apparel/jewelry" and "appliances" categories. These cases often involve high-profile brands and trademark disputes.

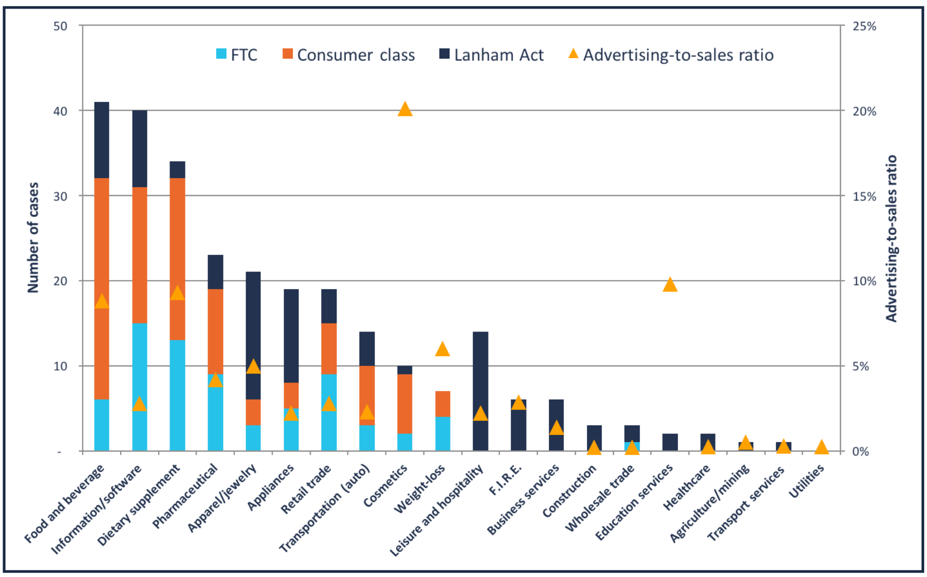
18 As noted above, *AdAge* data for 2010 were used for the charts in this section. Data available for other years showed that the ratios remained fairly constant over the period shown in the charts.

Chart 3: False or Deceptive Advertising Cases by Product Category and Litigation Type



One factor driving the distribution of cases is the importance of advertising. Chart 4 overlays onto Chart 3 a measure of advertising intensity (advertising-to-sales ratios). The left-hand side of the chart shows product categories where advertising is more important to generating sales—and thus potential disputes. Conversely, there exist other products purchased by consumers where advertising is less critical, such as utilities and transportation services.

Chart 4: Relationship between False or Deceptive Advertising Cases and Advertising by Product Category



One of the interesting patterns from Chart 4 is not just that filings tend to be correlated with the weight of advertising, but where the opposite is true. For example, "cosmetics" and "education services" have high advertising intensities but low case representation. These may be areas where future litigation is more likely. On the other hand, messages about appearance or higher learning may be important to consumers but difficult to prove true or false.

Relationship Between Brands and False Advertising Litigation

The nexus between brands and false or deceptive advertising disputes highlights another significant difference between Lanham Act cases and FTC enforcement actions. While Lanham Act false advertising cases are often in conjunction with trademark infringement cases, FTC actions are typically focused on less high-profile brands. Inspection of Lanham Act cases in the charts above shows that plaintiffs have, at some time in the past, also filed separate Lanham Act trademark infringement lawsuits. This is consistent with the Lanham Act being used as a tool to protect advertising, which can be a means to stimulate sales in the short term and build reputational assets with trademarks and brands over the long term.[19]

By contrast, many FTC false advertising enforcement actions appear to target companies with fewer reputational assets at stake. For example, a study of FTC deceptive advertising actions pointed out that "75% of firms charged with deceptive advertising by the FTC between 1996 and 2002 could not be found in any of five major business databases."[20] These databases track thousands of businesses in the United States, not just publicly traded companies. Hence, at least some FTC targets have been lesser-known firms with possibly fewer reputational assets.

Second, a review of the specific firms involved in the various litigation types shows that many of the FTC target firms in the charts above appear to have had little participation in Lanham Act litigation generally and in trademark infringement cases specifically.[21] It is difficult to draw generalizations, because FTC deceptive advertising actions have in some instances targeted high-profile brands; however, the majority of FTC cases are focused on companies with less-established reputations and fewer intangible assets to protect. It is possible, as noted in the FTC's deceptive advertising enforcement guidelines, that its actions have targeted some companies lacking the reputational marketplace incentives to deter them from opportunistic deception.

19 The Lanham Act was enacted in 1946 and originally covered trademark protection. It was later extended to cover claims of "false or misleading" commercial advertising.

20 John Cawley, Rosemary Avery, and Matthew Eisenberg, "The effect of advertising and deceptive advertising on consumption: the case of over-the-counter weight loss products," paper presented at the Institute for the Study of Labor conference in April 2011 (March 29, 2011), p. 7.

21 Based on CourtLink searches for parties named in Lanham Act trademark disputes.

Consumer Benefits from Competition and Lower Prices: The Debate over Sweetener Ingredients

Last, this article turns to a recent high-profile false advertising case that reached trial in November 2015 and settled two weeks into trial. In *Western Sugar Cooperative et al. v. Archer Daniels Midland Co. et al.*, a group of sugar producer Plaintiffs filed a false advertising lawsuit under the Lanham Act. The Plaintiffs stated that a multiyear, multimedia national advertising campaign led by the Corn Refiners Association (CRA) convinced consumers to switch from sugar-sweetened food and beverage products to HFCS-sweetened products. The alleged false advertising was presented to consumers through several media channels, including television, print, and the Internet. At trial, Plaintiffs' economic expert testified that false advertising caused damages in excess of $1 billion, even though the CRA only spent a total of $130 million on the challenged advertising.[22]

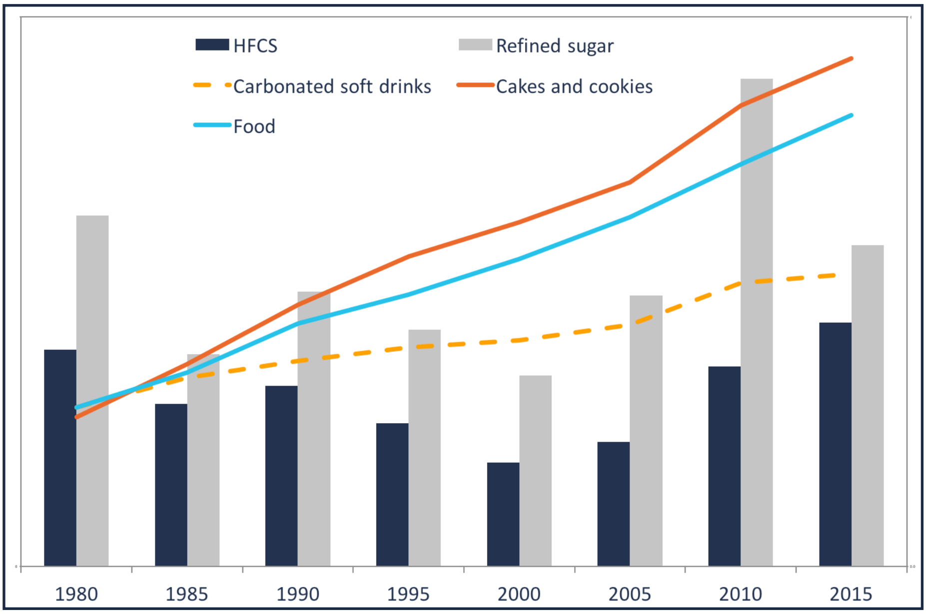
One of the Plaintiff's allegations was that the alleged false advertising persuaded companies, like Coca-Cola, not to switch its product sweeteners from HFCS to sugar. Assuming manufacturers make sweetener ingredient choices to maximize profits, the relative costs of HFCS and sugar is one factor taken into account when evaluating whether the challenged advertising might have influenced sweetener choices. Plaintiffs' alleged the false advertising, in addition to targeting manufacturers, targeted consumers of products containing sweeteners. Thus, the food and beverage prices paid by consumers might also be relevant to evaluating whether the challenged advertising affected their decisions.

An analysis of the relative costs of HFCS and sugar can be done using historical data from the U.S. Department of Agriculture. As shown in Chart 5, as far back as the 1980s, HFCS costs on a per-pound basis have consistently been lower than sugar costs. Starting around this time, many companies, particularly carbonated soft drink manufacturers, began reformulating their sodas from sucrose sugar to HFCS. Today, many manufacturers offer consumers a choice of either an HFCS- or sugar-sweetened variety of the same or similar product.[23]

22 See Sindhu Sundar, "All Eyes On Expert Testimony In Corn Syrup False Ad Trial," *Law360* (November 2, 2015).

23 For example, many popular branded carbonated sodas and products in other food and beverage categories are offered in HFCS- and sugar-sweetened varieties, such as Pepsi Throwback or Simply Heinz ketchup.

Chart 5: BLS Food and Beverage Price Indexes and Wholesale Sweetener Costs



The costs in Chart 5 are shown at five-year intervals. On a higher frequency basis, such as quarterly, HFCS costs have also been more stable than sugar. Over the entire timeframe from 1980 to 2015, the relatively lower and more stable costs of HFCS coincided with a decline in the price of carbonated soft drinks relative to other goods, especially cakes and cookies that continued to be sweetened largely with sucrose sugar.[24] Given that carbonated soda is among the largest food and beverage product groups by sales, the cost savings passed on to consumers has been substantial.[25] Some of the cost differential may be attributed to U.S. government policies that artificially raise sugar costs to U.S. consumers. Nonetheless, the effects of any challenged advertising would need to control for these substantial cost and price differences in order to isolate the alleged impact of advertising on consumers' product choices.

How the question of potential damages gets resolved in cases like *Western Sugar Cooperative et al. v. Archer Daniels Midland Co. et al.* should not ignore the benefits of lower prices for consumers, which ultimately makes their income go further at the grocery store and yields a wider assortment of product choices.

24 See USDA Economic Research Service, *Sweetener Consumption in the United States* (August 2005), Table 5 at p. 12.

25 See Table 2 in Bart J. Bronnenberg, Michael W. Kruger, and Carl F. Mela, "The IRI marketing data set," *Marketing Science* 27:4 (July–August 2008), pp. 745–748.

Solar Power for the United States

Neil Shifrin, Ph.D.[*]

Abstract

What would it cost the United States to transition its electric power capacity to solar? Based on currently operating solar projects, this paper estimates the cost at $17 trillion. Great challenges would exist for a massive conversion to solar power, though none of these appear insurmountable. However, the cost itself would surpass some of the greatest expenditures in U.S. history, such as placing a man on the moon and even fighting World War II. While the posed question is in many respects solely academic, in other respects it confronts us with the costs and other challenges related to our limited carbon future.

Introduction

Interest in renewable energy sources continues to increase as the limitations of carbon fuels become better understood. These limitations manifest as increased cost, more extreme extraction requirements, pollution, and climate change threats. Fortuitously, technology improvements for renewable energy have increased efficiencies and decreased unit costs to the point that we may be on the verge of economic feasibility. However, scale will remain an issue. This paper examines one renewable energy source—photovoltaic conversion of solar energy to electricity—in terms of its requirements for satisfying all U.S. energy demand. About 39 percent of this total demand in the United States is for electricity.

The Nature of Solar Energy as a Renewable Energy Source

The energy contained in sunlight is a function of wavelength. The foolproof method of accounting for solar energy is to count photons, which would result in an insolation unit of Einsteins per unit area (of earth) per time. The more practical method commonly used is to account for insolation in terms of heat. By this means, the "solar constant" is generally recognized to be 2 cal/cm2 per second. About 40 percent of the solar radiation coming to earth is available at the surface. The average solar radiation on a horizontal surface in the United States is about 1.4 million Kcal/m2 year.[1] Seasonal variations and weather make this value vary by about a factor of two at any given time. Given the total surface area of the United States (3.81 million square miles), the total solar irradiation on the United States is 1.38 × 1019 Kcal/year. The average solar irradiation

* Neil Shifrin, now retired, was an environmental consultant for 45 years specializing in water quality and hazardous waste. Dr. Shifrin wrote a Ph.D. thesis on solar energy.

1 W.E. Reifsnyder and H.W. Lull, *Radiant Energy in Relation to Forests,* Tech. Bull. No. 1344, U.S. Department of Agriculture, Forest Service (1965).

reaching the entire earth is about 500 × 1018 Kcal/year.[2,3] This constant influx (until the sun's demise) represents the potential of "solar energy."

Conversion of this irradiation to useful energy is, of course, the tricky part. Several approaches, including biomass, thermal, and photovoltaics, are being pursued. From an engineering perspective, a successful conversion vehicle must be practical, reliable, and efficient (e.g., cost effective). For example, biomass conversion uses only visible light, which constitutes 50 percent of irradiation. The most efficient conversion (by algae) is perhaps only a few percent of this on the basis of a potential maximum biomass production rate of about 20 gm/m^2 day, gross (i.e., ignoring energy input requirements for aquaculture and harvesting), which would require at least 1 billion acres to satisfy the U.S. energy demand.

Photovoltaic panels currently convert about 15 percent of solar irradiation, at best (laboratory experiments have been as high as 40 percent). Current limitations on photovoltaic use include the cost of silicon-based panels, the effect of heat (most panels are less efficient as they heat up), lost photon-electron reactions (some electron excitations cannot currently be captured), and location requirements. Technology improvements, such as non-silicon-based panels and better electron capture, may someday provide solar panels that run at 30 percent efficiency or more, but the estimate below is based on *current* capabilities.

What Will It Take?

Although it is possible to paint a brighter picture by using theoretical capacities and cost factors, it is estimated that solar capacity to satisfy all US energy requirements would have a capital cost of $17 trillion ($2.4 trillion to satisfy just electricity demands) and a lifetime total cost of over five times that amount. This estimate is based on *actual* installations, today, according to the following basis (also, see Appendix):

- A large-scale photovoltaic system recently installed in Japan:[4]
  - 70-megawatt installed capacity in a 0.5-square-mile area.
  - At a capital cost of $44 million, but a "total investment cost" of $275 million.[5] Although the latter is not explained in the reference, the difference is probably due to land, infrastructure, and lifetime maintenance costs.

2 N.K. Boardman, "Solar Energy Conversion in Photosynthesis and Its Potential Contribution to World Demand for Liquid and Gaseous Fuels," Proc. Fourth Int. Cong. Photosyn., Great Britain (1977), 635–644.

3 M. Slesser and C. Lewis, *Biological Energy Resources*, New York: John Wiley and Sons (1979), 192 p.

4 American Society of Civil Engineers, *Civil Engineering* 84(1): 22 (January 2014).

5 "KYOCERA Starts Operation of 70MW Solar Power Plant, the Largest in Japan," Kyocera website (November 5, 2013), accessed December 22, 2015, at: http://global.kyocera.com/news/2013/1101_nnms.html

- A small-scale system installed by the author in New Hampshire:
  - 7.95-kilowatt installed capacity (30 panels).
  - 8,300 kW hr/yr actually produced in 2015.
- U.S. energy demand:
  - 98.49 quads[6] in 2014.

A 2014 date for the U.S. energy demand was selected as the most recent reliable data, but demand and conservation variations make future predictions difficult. To put this value in perspective, the 1975 U.S. energy demand was 75 quads, and the United States used 2 quads in 1850.

Generation rates or efficiencies might be expected to vary with latitude or weather cycles. Surprisingly, the difference is minor. A survey by the Solar Energy Industries Association noted a variation of only about 25 percent around the country for an actual generation rate per installed capacity (e.g., kW hr/kW/yr), with Nevada at the top at about 1,700 kW hr/kW/yr and Vermont near the bottom at 1,200 kW hr/kW/yr.[7] In 2012, Arizona had 1,100 megawatts of installed capacity.[8] The author's own residential system will generate 8,300 kW hr/yr with 8 kilowatts of installed capacity, or 1,050 kW hr/kW/yr (only a partial year of data to date). It is unclear why this value is lower than the survey, but it might be due to different types of systems. Given the relatively small geographical variation of efficiency, the estimate of $17 trillion for the full United States remains reasonable for this analysis.

Discussion of Feasibility

This capital cost estimate is similar to the U.S. GDP, which was $17.4 trillion in 2014. However, vagaries abound, as shown in the cited references that indicate a "total investment cost" of over five times the capital cost. Although cost improvements continue, the spread between capital and "total" in the literature suggests the hidden costs of full implementation such as for land, transmission, maintenance, and replacement.

Scaling the experience in Japan of large-scale installed capacity (0.5 square miles/70 megawatts), an estimated area of 190,000 square miles, or 121 million acres—5 percent of the United States—would be required to satisfy the entire U.S. energy demand. For just electricity demands, 18 million acres would be required.

Cost, practicality (e.g., land availability), and the paradigm change of a new energy future are the significant challenges of a full conversion to photovoltaics. A GDP-magnitude cost implemented over decades is not impossible. For example, companies like Exxon-Mobil have annual revenues of

6 A quad is a quadrillion British thermal units. 1 kW hr = 3,400 BTU.

7 Solar Energy Industries Association (SEIA), "What's In a Megawatt?" (2014), accessed November 11, 2014, at: www.seia.org/policy/solar-technology/photovoltaic-solar-electric/whats-megawatt

8 Interstate Renewable Energy Council, Annual Update and Trends, Chicago (2013).

$500 billion, which makes their stake in this transition future feasible. Government intervention beyond current subsidies, which are actually useful and effective, will also be required to get these energy companies to retool. Although photovoltaics are growing at impressive rates,[9] they still offer only a tiny fraction of overall demand, and the government could do more now, such as *requiring* installation in new construction. Why not build every new house with photovoltaics and view the capital cost no differently than that of a furnace?

Since our carbon future is clearly limited, a more important question for the paradigm change is: how far should photovoltaics go? Using photovoltaics for electricity needs is an easy consideration, because it would replace the same form of energy and the economics, although painful, might be reasonable. But can solar energy also satisfy other carbon fuel demands, such as for transportation? Another interesting question: is solar energy best generated by a distributed versus a centralized system, or what is the best combination of the two? It is more likely that photovoltaics will play a partial, albeit increased, role in the total U.S. energy future. To put the costs into further perspective, consider some recent major events: the U.S. man-on-the-moon project cost an estimated $200 billion, while World War II cost an estimated $1.6 trillion in today's dollars.

Another challenge will be power transmission. To a large degree, the existing grid can be used and will be particularly adaptable to a distributed system. The existing grid may also be necessary for transmission during dark periods, depending on the final system design (e.g., local storage versus alternative fuel generation). Large, centralized generation in remote locations will still be likely, however, and such transmission will add to the total cost. The amount will depend on the mix of distributed and centralized generating capacity.

Everyone hopes that yet another "technology fix" will bail us out of today's dim energy trajectory. There is no question that photovoltaics will benefit from technology improvements, such as with panel efficiencies and battery improvements. Feasibility is a function of both cheaper solar cells and the higher price of carbon fuels. Every single percentage point of increased operating efficiency might translate to about a $500 billion savings in installed capacity and 8 million fewer acres required. However, photovoltaics look half as feasible with gas at $2 per gallon compared to $4 per gallon.

In addition to these basic economics, we must also focus on bigger matters such as project phasing, the right government–private combination, the best system design, fuel-type substitution, land use, and manufacturing capacity. We tend to be amazingly shortsighted when it comes to energy, perhaps because petroleum has been subsidized for so long in the United States, but one fact is inescapable—our carbon future is limited. Whether carbon fuels last 50 or 500 more years misses the point.

9 SEIA (2014).

Appendix: Costs of Solar Power for U.S. Demand

Basis of Analysis

Metric	Figure Used in Analysis	Reference
U.S. Energy Demand	98.49 Quads	For 2014: www.eia.gov *
Large-System Installed Cost	$44 million for 70 MW, "all in"	*Civil Engineering* **
Small-System Installed Cost	$35,000 for 7.95 kW, "all in"	Personal experience
Small-System Generation	8,300 kW hr/yr from 7.95 kW system	Personal experience

* U.S. Energy Information Administration, accessed January 13, 2016.

** American Society of Civil Engineers, *Civil Engineering* 84(1): 22 (January 2014).

Conversions

$1\ kW\ hr = 3{,}400\ BTU$

$1\ Quad = 1 \times 10^{15}\ BTU$

Calculations

Annual power requirement (total U.S. energy demand):

$$98.49 \times 10^{15} BTU * \frac{1\ kW\ hr}{3{,}400\ BTU}$$

$$= 2.9 \times 10^{13} kW\ hr$$

Unit generation capability:

$$8{,}300\ kW\ hr/yr\ * \frac{1\ yr}{7.95\ kW}$$

$$=\ 1{,}044\ kW\ hr\ /\ kW/yr$$

Total U.S. capacity requirement:

$$\frac{Power\ Requirement}{Unit\ Generation\ Capability}$$

$$= \frac{2.9\ x\ 10^{13} kW\ hr}{1,044\ kW\ hr\ /\ kW/yr}$$

$$= 2.77 \times 10^{10}\ kW$$

$$= 2.77 \times 10^{10}\ kW * \frac{1\ MW}{1{,}000\ kW}$$

$$= 2.77 \times 10^{7}\ MW$$

Cost of total U.S. installed capacity:

$$U.S.\,Capacity\ Requirement\ *\ Large\ System\ Installed\ Cost$$

$$= 2.77 \times 10^{7}\ MW\ *\ \frac{\$44\ Million}{70\ MW}$$

$$= \$1.74 \times 10^{13}$$

Total Installed Cost of Solar Capacity to Provide Total U.S. Demand: $17 Trillion***

*** Based on New Hampshire generation rates

Estimating the Costs of Solar Conversion in the United States[1]

Daniel Michel[*]

Abstract

This paper takes previous research conducted by the National Renewable Energy Laboratory regarding solar energy costs to estimate the cost it would take for the United States to convert to 100 percent solar energy by 2050. This paper estimates a total cost of approximately $5.6 trillion.

Introduction

In the United States, energy expenditures account for nearly 5 percent of disposable income,[2] and the costs of energy represent an important policy concern. The concept of "renewable energy" feels quixotic, yet some predict that a future of renewable energy is approaching rapidly. Other countries are already moving in this direction: Germany, in the face of rising energy prices, now uses 31 percent renewable energy nationally and aims to augment this percentage greatly over the coming years.[3] In 2011, Mark Delucchi and Mark Jacobson predicted that the current U.S. energy system could be converted to 100 percent renewable energy by 2050, but they did not ascribe a total cost to such a conversion.[4] This paper builds upon the existing literature on the costs of solar energy by developing a cost calculation from these previous studies. Using the year 2050 proposed by Delucchi and Jacobson as a target, this paper estimates the cost of converting the entire U.S. energy grid to solar energy by 2050 to be approximately $5.6 trillion.

Background Information

Solar power plants are normally measured by their "nameplate capacity," which is the maximum amount of power a solar plant is capable of generating, in megawatts.[5] Since solar power plants do not operate at peak capacity 24 hours a day, this capacity number needs to be considered in

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1 Thanks to Sandra Wetzel and Daniel Boada for their research assistance on this paper.

2 U.S. Energy Information Administration, "Consumer energy expenditures are roughly 5% of disposable income, below long-term average" (October 21, 2014), accessed at: http://www.eia.gov/todayinenergy/detail.cfm?id=18471

3 Caroline Winter, "Germany Reaches New Levels of Greendom, Gets 31 Percent of Its Electricity from Renewables," Bloomberg Businessweek (August 14, 2014), accessed at: http://www.businessweek.com/articles/2014-08-14/germany-reaches-new-levels-of-greendom-gets-31-percent-of-its-electricity-from-renewables

4 Mark A. Delucchi and Mark Z. Jacobson, "Providing all global energy with wind, water, and solar power, Part II: Reliability, system and transmission costs, and policies," *Energy Policy* 39 (2011), accessed at: http://web.stanford.edu/group/efmh/jacobson/Articles/I/DJEnPolicyPt2.pdf

5 National Renewable Energy Laboratory (NREL), "Solar Energy and Capacity Value" (September 2013), p. 2, accessed at: http://www.nrel.gov/docs/fy13osti/57582.pdf

conjunction with a plant's "capacity factor," which is the percentage of maximum possible output actually produced by the plant over a certain period of time.[6] Power plants also lose about 7% of their generated energy between the point of generation and delivery to the customer.[7] As an example, a new solar power plant in Japan has been announced with a capacity of 70 MW that is expected to produce 78,800 MWh annually.[8] This equates to a capacity factor of 12.8 percent.[9] That also means that of the 78,800 MWh produced by the Japanese power plant, 7 percent will be lost in the transmission and distribution process, while 73,284 MWh (93 percent of 78,800) will be consumed in Japan.

In evaluating the cost of converting the entire United States energy grid to solar energy by 2050, four primary components must be considered on an annual basis for each year from now until 2050:

- The annual amount of solar power consumed
- The installation costs per watt of solar plant capacity
- The energy grid update costs per watt of solar plant capacity
- The solar plant capacity factor[10]

Each factor is discussed individually below in creating total cost estimation for solar conversion.

Initial Assumptions

Several solar power technologies are currently in the market. Concentrating Solar Power (CSP) collects solar thermal energy and converts it into power.[11] An alternative means of collecting solar energy is photovoltaic (PV) technology, which converts sunlight directly into energy in solar panels. PV is now considered the most viable form of solar technology.[12] PVs can be installed in a variety of settings, including residential rooftops, commercial rooftops, and rural utility-scale photovoltaic systems.[13] When contemplating a mass implementation of solar energy, ground-

6 NREL (2013).

7 U.S. Energy Information Administration (EIA), "Annual Energy Review: Electricity Flow," footnote 5, accessed at: http://www.eia.gov/totalenergy/data/annual/diagram5.cfm

8 Kyocera, "Kyocera Starts Operation of 70MW Solar Power Plant, the Largest in Japan," press release (November 5, 2013), accessed at: http://global.kyocera.com/news/2013/1101_nnms.html

9 12.8 percent = 78,800 MWh/(70 MW*[24 hours in a day]*[365.24 days in a year])

10 Note that certain costs are omitted from this analysis for purposes of simplicity. A more detailed analysis would need to consider wide-scale implementation costs unique to solar energy. For example, a real-world conversion to solar energy would also likely incur the following costs: costs associated with storing solar power for use at night; potential increased costs associated with providing ancillary services using solar power; costs associated with maintaining solar energy farms; costs associated with decommissioning existing power plants; and aesthetic costs of widespread solar farms. Finally, solar power plants would be more effective in certain parts of the country such that the energy infrastructure would likely undergo a complete overhaul to take advantage of these regional discrepancies.

11 Anthony Lopez, Billy Roberts, Donna Heimiller, Nate Blair, and Gian Porro, "U.S. Renewable Energy Technical Potentials: A GIS-Based Analysis," Technical Report NREL/TP-6A20-51946 (July 2012), p. 8, accessed at: http://www.nrel.gov/docs/fy12osti/51946.pdf

12 Ken Wells and Mark Chediak, "Solar Energy Shakeout: Concentrating vs. Photovoltaic," Bloomberg Businessweek (November 14, 2013), accessed at: http://www.businessweek.com/articles/2013-11-14/2014-outlook-solar-energy-shakeout-concentrating-vs-dot-photovoltaic

13 Lopez et al. (2012), pp. 3–5.

mount utility-scale fixed-axis PV systems are the most practical opportunity. These systems are the "least costly deployment of solar power due to economies-of-scale in construction and operation" and "have the ability to locate in the areas of best solar resource."[14] PV systems are the easiest to implement on a large scale, which differentiates this solution from other solar energy options.[15] Because of PV's relatively economical costs and the comparative viability for mass implementation, this paper assumes that all additional energy beyond our current capabilities will be generated through this type of PV system.

Furthermore, the only costs considered in this report are those related to creating solar power plants and connecting those plants to the energy grid. While implementing this project on such a massive scale would likely produce hidden complications, it could also provide unexpected innovations. For example, Swanson's law, the suggestion that the cost of PV cells will fall by 20 percent each time the global manufacturing capacity of these cells doubles, could provide guidelines for solar innovation, but there is little evidence that this trend will hold in the long term.[16] Instead, only the predictions currently found in reliable solar energy forecasts are incorporated into the pricing model used for this paper.

Finally, this paper relies heavily on the findings of the National Renewable Energy Laboratory (NREL), described as the U.S. Department of Energy's (DOE) "primary national laboratory for renewable energy and energy efficiency research and development."[17] The NREL has extensively researched trends in the average installation costs of photovoltaics in the United States and has produced many publicly available articles on solar energy.

Projections for 2050

Annual Amount of Solar Energy Consumed

According to the DOE, the United States consumed roughly 28 million gigawatt-hours (GWh) of electricity in 2012.[18] Of this amount, only 0.23 percent was generated by solar power.[19] The U.S. Energy Information Administration predicts an annual increase of energy consumption of about 0.03 percent between 2012 and 2040.[20] Extrapolated to 2050, the U.S. energy need for the year 2050 is predicted to be approximately 31 million GWh. To reach 100 percent solar energy between 2015

14 NREL, "Solar Power and the Electric Grid" (March 2010), p. 3, accessed at: http://www.nrel.gov/csp/pdfs/45653.pdf

15 Alan Goodrich, Ted James, and Michael Woodhouse, "Residential, Commercial, and Utility-Scale Photovoltaic (PV) System Prices in the United States: Current Drivers and Cost-Reduction Opportunities," Technical Report NREL/TP-6A20-53347 (February 2012), p. 12, accessed at: http://www.nrel.gov/docs/fy12osti/53347.pdf

16 Geoffrey Carr, "Sunny Uplands," *The Economist* (November 21, 2012), accessed at: http://www.economist.com/news/21566414-alternative-energy-will-no-longer-be-alternative-sunny-uplands

17 NREL, "Leading the Way to Energy Systems Research" (April 2015), accessed at: http://www.nrel.gov/docs/fy15osti/64071.pdf

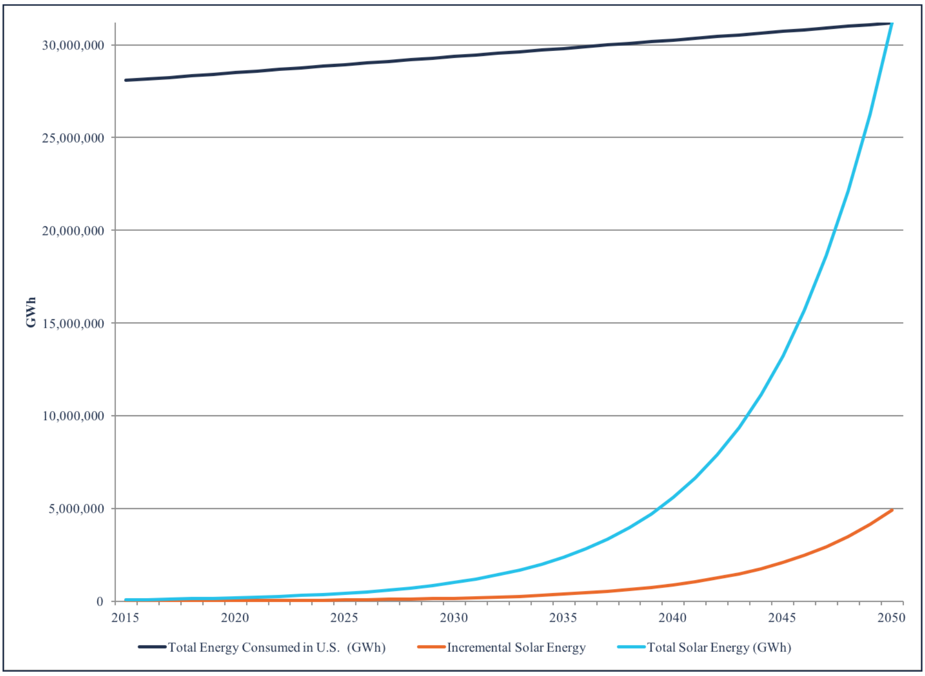
18 U.S. EIA, "International Energy Statistics" (n.d.), accessed at: http://www.eia.gov/cfapps/ipdbproject/IEDIndex3.cfm?tid=44&pid=44&aid=2. This number is converted from 94.946 quadrillion BTU (another energy unit) to KWh.

19 U.S. EIA, "Frequently Asked Questions" (last updated June 13, 2014), accessed at: https://web.archive.org/web/20141022014734/http://www.eia.gov/tools/faqs/faq.cfm?id=427&t=3

20 U.S. EIA, "Annual Energy Outlook 2014" (April 2014), accessed at: http://www.eia.gov/forecasts/archive/aeo14/

and 2050, the United States would need to increase its percentage of solar energy relative to total energy consumption by approximately 18 percent each year from 2015 until 2050. This gradual proliferation of solar energy assures that the greatest transition to solar occurs toward the latter portion of this period. Figure 1 shows the total energy consumed in the United States until 2050, as well as the portion of energy consumption comprising solar power.

Figure 1: Solar Energy Consumption over Time



Installation Cost per Gigawatt over Time

In 2010, the NREL assembled a bottom-up analysis of the installation costs for several types of solar energy systems, including the fixed-axis PV system. For each type of system, the NREL calculated the "unsubsidized cash purchase price of PV systems," a measure it explained best approximates the book value of an energy asset.[21] In developing this price, the NREL included all major cost centers for an energy installation project. These costs included the materials, labor, overhead, and land acquisition and preparation, as well as regulatory costs involved in solar installations.[22] With these factors in mind, the NREL determined the current average of a 187.5 MW capacity[23] utility-scale fixed-axis ground mount to be \$3.80/W, or \$3.8 billion/GW of capacity installed.[24]

21 Goodrich et al. (2012), p. 3.

22 Ibid.

23 The NREL uses this solar plant size since it considers it a size in which most economy of scale benefits through plant size are sufficiently achieved (Goodrich et al., 2012, p. 13). The NREL says that systems based on this module require approximately 8 acres/MW of capacity.

24 Goodrich et al. (2012), p. iv.

In the same paper, the NREL projected the evolutionary cost reductions for PV installation through 2020, assuming an advancement of the PV market through competition among installers, improvements in regulations, and supply-chain cost reductions.[25] In its determination of this forward-looking figure, the NREL determined a cost of $1.71/W of capacity for utility-scale fixed-axis ground mount by 2020.[26] In 2012, an update of this NREL report produced by the DOE reinforced the reliability of the initial NREL model by showing that the 2010 bottom-up model was largely in line with 2012 actual reports.[27]

Assuming that this decline from 2012 through 2020 is a fixed percentage throughout this period, the NREL predicts an annual drop of installation prices per watt of capacity at 5.3 percent. NREL attributes a majority of this cost reduction to the drop in the input prices for PV modules. PV modules are composed primarily of crystalline silicon (c-Si) or cadmium telluride (CdTe).[28] An appendix of the 2010 NREL report, "Long Term Module Price Trajectories," forecasts the cost of these components into the future, predicting that these inputs will asymptote between 2020 and 2040.[29] For the sake of estimation, these inputs and all other installation costs are assumed to level out in 2030 and stay constant for the final 20 years of solar installation. By using this same 5.3 percent annual decline, a "maximum efficiency" installation cost is estimated to be $1.05/W of plant capacity by 2030. This projection is almost consistent with the goals set forth by the DOE's SunShot initiative, which sets a fixed-axis PV system installation cost target of $1.00/W of plant capacity.[30]

Grid Update Costs

Construction of new transmission infrastructure should also be considered in projecting future costs. While the existing grid will be utilized as much as possible, there will undoubtedly be costs of integrating new solar farms to the grid. The NREL projects these costs to be between $1.00/W and $4.00/W of capacity.[31] These are significant costs; the NREL adds that the "the high end of this estimated range would be prohibitive for project developers."[32] Although the NREL does not provide long-run cost predictions, this paper assumes that these cost reductions mimic the cost reductions of installation costs. To predict the infrastructure costs from now until 2050, this paper starts with an infrastructure cost of $2.00/W of capacity, then declines on the previously discussed 5.3 percent annual basis until it eventually asymptotes along with installation costs at $0.83/W of capacity in 2030 along with installation costs.

25 Ibid. This model does not assume "revolutionary improvements" to PV module development over the 10-year period (Goodrich et al., 2012, p. 34).

26 Ibid, p. 30.

27 U.S. Department of Energy, "Photovoltaic (PV) Pricing Trends: Historical, Recent, and Near-Term Projections," SunShot (November 2012), pp. 13–14, accessed at: http://www.nrel.gov/docs/fy13osti/56776.pdf

28 Goodrich et al. (2012), pp. 6, 13.

29 Ibid, pp. 52–53.

30 Ibid, p. 29.

31 Ibid, p. 49.

32 Ibid.

Photovoltaic Capacity Factor Gains

While gains in the cost per "nameplate capacity" of PV power plants predict a large cost decline until 2030, they only show part of the opportunity for cost improvements. Over time, PV plants are also projected to improve their capacity factor and therefore decrease both installation and infrastructure costs while more energy can be extracted from plant capacity. In its 2010 paper, the NREL assumed a capacity factor around 14.5 percent efficiency.[33] This is in the range of the Japanese example previously discussed.[34] The NREL projects module capacity factor to improve to around 21.5 percent by 2020, or a 4 percent annual improvement in PV efficiency for each year. Further, it projects a maximum-capacity efficiency level around 24 percent.[35]

Another NREL paper examined the PV potential on a state-by-state level and also estimated a national capacity factor around 24 percent, cementing this maximum-capacity assumption.[36] Using the NREL's 4 percent annual improvement rate, this paper projects efficiency gains to reach a 21.5 percent capacity factor by 2020, then eventually level off around 24 percent starting in 2023.

Calculations

Using a combination of the projections described above, this paper arrives at an estimation of total costs of conversion. This calculation involves four primary steps to determine the annual cost of new solar energy installation from 2015 to 2050. First, an incremental amount of solar energy added needs to be determined. This can be determined through the following equation:

$$1.\ Incrementally\ Installed\ Solar\ Energy_{year} = [Total\ Energy_{year} \times Percentage\ Solar_{year}] - [Total\ Energy_{year-1} \times Percentage\ Solar_{year-1}]$$

This equation shows that the incremental solar energy needed for a given year is a function of the total energy consumption for the United States and the percentage of which this energy is solar energy. This also assumes that none of the previous year's solar production power is lost over time. In reality, some solar capacity would have to be replaced when it expired due to, for example, malfunction or damage.

The second calculation involves converting the costs from projections per W of plant capacity to costs per GWh. This will allow a comparison between the energy plant improvements calculations and U.S. energy consumption needs. The equations are nearly identical for installation and infrastructure costs:

33 Ibid, p. 21.

34 Kyocera (2013).

35 Goodrich et al. (2012), p. 23.

36 Lopez et al. (2012), p. 13.

$$2a.\ Installation\ Cost\ /GWh_{year} = \frac{Installation\ Cost_{per\ W\ of\ capacity} \times 10^9_{unit\ conversion\ to\ GW}}{0.93_{Transmission\ and\ Distribution\ Losses} \times Annual\ Capacity\ Factor \times 8765.8_{hours\ in\ a\ year}}$$

$$2b.\ Infrastructure\ Cost\ /GWh_{year} = \frac{Infrastructure\ Cost_{per\ W\ of\ capacity} \times 10^9_{unit\ conversion\ to\ GW}}{0.93_{Transmission\ and\ Distribution\ Losses} \times Annual\ Capacity\ Factor \times 8765.8_{hours\ in\ a\ year}}$$

Having established an annual cost for installation and infrastructure of newly installed solar plants, and the incremental expected consumption of solar energy in GW, these numbers can be multiplied together for an annual cost of the new solar energy added to the U.S. energy system:

$$3a.\ Installation\ Cost_{year} = Incrementally\ Installed\ Solar\ Energy_{year} \times Installation\ Cost\ /GWh_{year}$$

$$3b.\ Infrastructure\ Cost_{year} = Incrementally\ Installed\ Solar\ Energy_{year} \times Infastructure\ Cost\ /GWh_{year}$$

The final equation simply adds the installation and infrastructure costs:

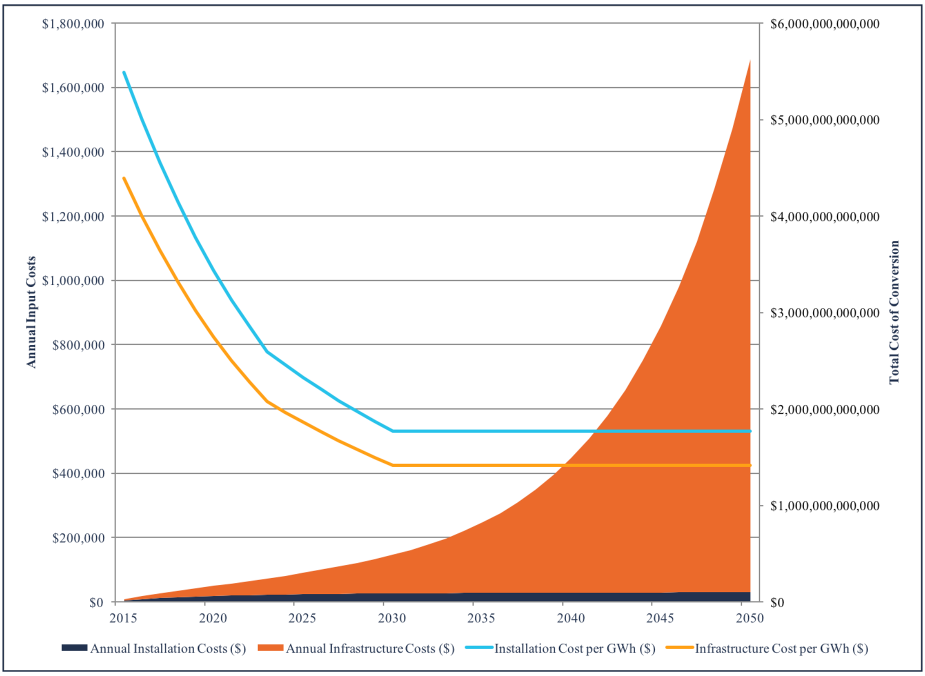
$$4.\ Annual\ Cost\ of\ Switch\ to\ Solar = Installation\ Cost_{year} + Infrastructure\ Cost_{year}$$

Results

The calculation described above provides the total cost for each year of the solar energy addition. I added a discount rate of 3 percent to adjust the annual costs to their present value.[37] Adding the annual costs of upgrades from 2015 through 2050 amounts to a total cost of upgrading of $5.6 trillion measured in present dollars. This is composed of $99 billion in installation costs and $5.53 trillion of infrastructure upgrade costs. Figure 2 shows the cost of solar energy over time alongside the annual costs of installation and infrastructure upgrades.

37 Steinbach et al., "Discount Rates in Energy System Analysis," discussion paper, Fraunhofer ISI, p. 8, accessed at: http://bpie.eu/uploads/lib/document/attachment/142/Discount_rates_in_energy_system-discussion_paper_2015_ISI_BPIE.pdf

Figure 2: Total Solar Energy Costs



As shown in figure 2, the largest period of transition to solar energy occurs very near 2050, when most of the predicted installation and infrastructure costs have leveled off.

Figure 3 provides a summary of the annual calculation described above grouped into five-year averages.

Figure 3: Overview of Annual Installation and Infrastructure Costs 2015–2050

Five-Year Period	Average of Total Solar (GWh)	Average of Solar Energy as a Percentage of Total Consumption	Average of Incremental Solar Energy	Average of Annual Solar Capacity Factor	Average of Installation Cost per Watt of Capacity ($)	Average of Installation Cost per GWH ($)	Average of Annual Installation Costs with 3% Discount Rate ($)	Average of Grid Update Cost per Watt ($)	Average of Infrastructure Cost per GWH ($)	Average of Annual Infrastructure Costs with 3% Discount Rate ($)
2016–2020	131,782	0.46%	20,796	19.87%	2.02	1,254,870	9,097,210,384	1.61	1,003,055	17,882,807,059
2021–2025	311,019	1.08%	49,080	23.59%	1.54	801,775	3,682,789,449	1.23	640,882	23,390,949,026
2026–2030	734,041	2.51%	115,834	24.14%	1.17	594,860	1,730,331,222	0.94	475,489	35,528,597,902
2031–2035	1,732,422	5.84%	273,382	24.14%	1.05	531,897	973,881,596	0.84	425,161	65,679,482,203
2036–2040	4,088,713	13.58%	645,213	24.14%	1.05	531,897	619,045,294	0.84	425,161	133,713,921,628
2041–2045	9,649,829	31.57%	1,522,778	24.14%	1.05	531,897	393,494,525	0.84	425,161	272,222,195,389
2046–2050	22,774,527	73.41%	3,593,756	24.14%	1.05	531,897	250,116,485	0.84	425,161	554,179,595,703
Totals	**31,180,644**	**100%**					**$99,023,530,340**			**$5,528,412,429,910**
						Total PV Cost	**$5,627,435,960,250**			

Note: due to the exponential nature of the calculations, these numbers do not allow for a calculation of the total costs without a consideration of the expanded annual cost analysis.

Conclusion

Arriving at a total cost of conversion to solar energy of over $5 trillion shows that the costs of this transformation are astronomical but not inconceivable. The year 2050 as described by Delucchi and Jacobson might not be as farfetched as currently appears, but it would still require a complete overhaul of our current approach to energy. Finally, predicting the costs of energy well into the future requires a slew of assumptions, as evidenced above. While these assumptions help provide a more accurate estimation of solar energy costs, adjusting any could drastically affect the final number. This number serves as a suitable base prediction for this transformation, but the evolution of solar energy will unquestionably take us to unforeseen and unexpected places.

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