

Capturing the Sun:

*A Roadmap for Navigating Data-Access Challenges
and Auto-Populating Solar Home Sales Listings*

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Lawrence Berkeley National Laboratory

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Executive Summary

Capturing the Sun: A Roadmap for Navigating Data-Access Challenges and Auto-Populating Solar Home Sales Listings was supported by the Office of Energy Efficiency and Renewable Energy (Solar Energy Technologies Office) of the U.S. Department of Energy SunShot Initiative and numerous contributors. It promotes a vision of solar advocates and real estate advocates evolving together to make information about solar homes more accessible to home buyers and sellers.

Across the country, more than 1.1 million homes feature solar photovoltaic (PV) systems. Homeowners, and even renters and businesses, are recognizing the myriad benefits of solar power including cost savings, energy efficiency, reduced environmental impact, and increased energy security or independence. In addition, studies suggest that solar installations add value when a home is resold, and federal guidelines acknowledge the need to value solar appropriately in home appraisals. As this momentum continues, there is a need for solar advocates and real estate advocates to collaborate to make information about solar homes more accessible to home buyers and sellers—and to improve the process for listing, valuing, and closing a solar home.

Most logically, solar data should be attached to home listings in a multiple listing service (MLS), and automatic population is the best way to do this. Auto-population could vastly increase the quality and quantity of solar data available to real estate agents, appraisers, and consumers, which in turn would grow demand for solar homes. Moreover, accurate third-party verified information that is auto-populated into the MLS creates transparency in the real estate transaction.

The Roadmap presents the current state of auto-population in various markets. It also guides readers through a practical and realistic assessment to understand the challenges, assess the roadblocks, and determine the best

path forward for auto-population of solar data in each reader's local context.

The authors envision the Roadmap journey as being led by a Journey Leader, with a set of travel partners, together comprising the “Roadmap Navigators”. Journey Leaders could conceivably be real estate industry participants, solar industry advocates, representatives from state agencies or the federal government, NGO persons, holders of solar data, or even utility representatives. All of these individuals are discussed in the Roadmap (see the Roadmap Navigators section), including what qualities might be crucial for a Journey Leader to be effective and what value each of them can get from reading the Roadmap.

It will not be an easy journey. The primary challenge facing auto-population is *access to the data*. Data on residential solar systems exist today, ranging from descriptive characteristics—such as the system's address, ownership structure, size, and year installed—to electricity production. However, these data are held by numerous entities, including private installers, local and state permitting agencies, utilities, and other service providers. No single source provides *all* the access to all the data. There are significant limitations on what data are accessible, based on the local landscape, solar marketplace, and data holders. The most comprehensive and therefore useful solar data are currently private.



There is also the question of who is *liable* for the data. Because not all real estate professionals are educated on solar, liability arising from mistakes in manually entering

solar details on a listing is a concern. Auto-population might help reduce this liability by drawing solar data directly from a verified, secure source, but it could also raise different concerns about data sharing. Much of the reluctance to release the necessary information stems from a tension between data holders sharing data and acting as responsible custodians to respect customer privacy. A regulatory balance must be struck between the mandate of state and local governments to protect consumer privacy and the need to provide data access in support of an informed and effective marketplace.

As such, the Roadmap is grounded in reality. The metaphors of a roadmap and journey signify the orientation and guidance readers need to navigate the real complexities of solar data auto-population. Fortunately, readers need not make the voyage alone. Three *journey navigation* teams from across the country have been exploring their own auto-population strategies over the past several months, and their insights inform the Roadmap. In fact, collaboration among this group transformed the Roadmap's scope from an early focus on localized, disparate activities toward the collective vision of auto-population presented here. Taking this real-world perspective into account, the Roadmap recommends three implementation pathways for auto-population of solar data:

Direct to MLS: This public-private approach links a data holder to a private entity that wishes to publish the information, such as an MLS.

Publicly Funded Repository: This pathway focuses on the centralized aggregation of solar records in a repository that can deliver records to an MLS and other entities.

Solar Industry Collaborative Repository: This pathway brings together industry partners to design a solar data repository that could feed real estate listings and other outlets.

The Roadmap also highlights several data-access accelerators, or “barrier busters,” that readers can pursue in parallel or ahead of embarking on an implementation strategy. In addition, it identifies several real-world secrets to planning a successful auto-population journey, such as the following:

- Pick the right travel partners from different industries (see *The Roadmap Navigators*, page 11).
- Ask key questions early on to help prioritize the most feasible implementation strategy for a particular local market (see *Guidepost One: Landscape Assessment*, page 16).
- Use real estate industry standards to jump-start solar data transfer strategies (see *Guidepost Two: Solar Data Assessment*, page 29).
- Because data access is limited today, focus on achievable work-arounds to gain consumer consent and enable greater future access (see *Guidepost Three: Data-Access Assessment*, page 39, and Appendix A).
- Be prepared for complex technology requirements, such as creating an aggregated data repository (see Appendix B, page 70).

Despite the current limitations, auto-population of solar data is achievable. The Roadmap helps solar advocates take the first step by assessing the challenges and informing creation of robust, long-term implementation strategies. Progress is already being made in the real estate industry, as the growing demand for and inventory of solar homes makes investment in solar data auto-population more attractive to MLSs. More widespread use of solar auto-population will, in turn, increasingly simplify the sales process and satisfy consumer expectations—thus driving demand for more solar homes and all the benefits they bring.



Introduction

Capturing the Sun: A Roadmap for Navigating Data-Access Challenges and Auto-Populating Solar Home Sales Listings supports a vision of solar photovoltaic (PV) advocates and real estate advocates evolving together to make information about solar homes more accessible to home buyers and sellers and to simplify the process when these homes are resold.¹ The Roadmap is based on a concept in the real estate industry known as *automatic population* of fields. Auto-population (also called *auto-pop* in the industry) is the technology that allows data aggregated by an outside industry to be matched automatically with home sale listings in a multiple listing service (MLS).

One common example of auto-population is tax information. Today, tax data are automatically populated to an MLS, typically via a licensing agreement between the MLS and the tax aggregator.

Auto-population generally may offer several benefits to real estate agents, appraisers, and home sellers and buyers:

- The information could be more readily available in eligible fields when a listing is being prepared or the value of a home is being assessed.
- The information itself may be more accurate.
- Listing agents are more likely to have reduced liability, because the information comes from a verified source.

With solar data specifically, auto-population helps stakeholder industries collaborate to improve the process for listing, valuing, and closing a solar home. Auto-population simplifies the process, satisfies consumer expectations, and grows demand for solar homes. It could vastly increase the quality and quantity of data

available to real estate agents, appraisers, and consumers, thus helping overcome roadblocks related to training requirements or liability concerns.

The large and increasing inventory of solar homes makes solar data a prime and timely candidate for auto-population. As of the second quarter of 2016, more than 1.1 million U.S. homes had solar installations (SEIA and GTM 2016). In some ZIP codes and townships, up to 20% of homes have solar installations. Some subdivisions even feature solar on 100% of the homes. Inventories are likely to grow owing to projected solar cost reductions and favorable solar incentives such as leases and loans (SEIA and GTM 2016).

Real estate entities appear to be recognizing and supporting solar trends in the housing industry. Studies such as those from Lawrence Berkeley National Laboratory show that solar adds value when a home is resold (Hoen et al. 2015a, 2015b). Fannie Mae guidelines updated on August 30, 2016, address the valuation of homeowner-owned and third-party owned (TPO) solar systems, as do those of the Federal Housing Administration (FHA)/U.S. Department of Housing and Urban Development, most recently updated June 30, 2016 (Fannie Mae 2016, HUD 2016).

The availability and quality of solar data are also being improved. As this Roadmap highlights, auto-population is only possible when the target data are aggregated. Toward

¹ Throughout the Roadmap, a “solar” system means a “solar PV” system unless otherwise noted. The Roadmap is concerned with residential solar systems that use PV panels to transform the sun’s energy directly into electricity. Other solar energy technologies exist—such as solar water and space heaters and utility-scale concentrating solar power plants—but these are not the focus here.

this end, several innovative, potentially complementary initiatives could aid solar auto-population efforts, including the following:

- **Orange Button:** Focused on TPO solar systems where capital providers need performance-reporting standards (DOE 2016a).
- **U.S. Department of Energy (DOE) Standard Energy Efficiency Data Platform™ (SEED Platform):** Open-source software initiative to streamline the organization of complex commercial building data and sharing of selected data with partners or the public (DOE 2016b).
- **DOE Better Buildings Home Energy Information Accelerator:** Collaborative effort to expand the availability and use of reliable home energy information at relevant points in residential real estate transactions (DOE 2016c).

Despite this progress, the journey toward auto-population of solar data includes significant challenges, particularly in relation to data access and technology requirements. With regard to data access, numerous sources of solar data exist, but no single source provides all the access to all the data. With regard to technology requirements, auto-population is impossible until an aggregator organizes the data into a centralized repository or works with a vendor or partner to do so.

In some ways, the rapid growth of solar inventories has confused the real estate market. For example, real estate agents and appraisers might not have access to accurate details about solar systems. In some instances, listing agents may describe a home as “solar” when it only features solar path lights, or agents might not even mention existing solar owing to lack of training or liability fears, which may leave equity off the table for seller clients. Additional details, such as whether a system is owned or leased, might not be noted but are very important in understanding how the system might be transferred to a buyer and its value.



While challenges exist, the growing consumer demand—combined with increasing solar home inventories and innovative data initiatives—enhances the business case for MLSs to invest in making solar fields available. Auto-populating solar data into these fields will further improve the transaction. This Roadmap is designed to facilitate solar auto-population. Read on to learn how.



How to Use the Roadmap

The Roadmap helps readers assess roadblocks and determine the best path toward auto-populating solar data into MLSs or related real estate channels such as broker websites or real estate portals. Primary readers, or *Journey Leaders*, should read the entire Roadmap, whereas other stakeholders may wish to focus on specific sections. The Roadmap is divided into sections in the order that each step on the journey should be completed, each with definitions, examples, and exercises. In addition, three *journey navigation* teams—from San Diego, Massachusetts, and Colorado—have been exploring their own auto-population journeys over the last several months. Experiences from these teams are highlighted throughout the Roadmap as “Reflections from the Road.”



The Roadmap Navigators section identifies the various stakeholders and partners that may be involved with the auto-population journey. In this section, readers should identify their own role as well as the roles of others who may offer support throughout the process.

The three Guidepost sections include a landscape assessment, a solar data assessment, and a data-access assessment. Each section introduces a key element or concept and helps the reader contextualize what this means for their own journey. Each section also features Journey Leader exercises that give readers a hands-on opportunity to reflect on the content and examples in a local context. Journey Leaders should look for the Journey Leader Exercise icons and plan to pause and complete each of these key exercises. The Guidepost sections are complex but important. After completing the series of assessments, the Journey Leader will arrive at a welcome “fork in the road”—with the information needed to identify a preliminary strategy toward auto-population.



For a list of some of the guiding icons used in the Roadmap, please see Appendix E, page 87.

The Roadmap then describes the following three pathways to implementing auto-population and offers guidance on how to choose the most appropriate pathway for specific contexts:

- Direct to MLS pathway
- Publicly funded repository pathway
- Solar industry collaborative repository pathway

Before concluding, the Roadmap offers a “preview” of implementation—a few high-level thoughts to keep in mind when taking the next step. The appendices present additional resources, including detailed information on several “barrier busters” that readers can pursue before or during implementation of their strategies.

Let your auto-population journey begin!



The Roadmap Navigators

Navigating the complexities of auto-population requires collaboration between the **Journey Leader** and other “travel partners,” including data holders, data aggregators, bridge partners, and regulatory champions. This section helps readers understand these different roles and the value of the Roadmap to each group.



A Helpful Framework: Beginning, Middle, and End

To better understand the various Roadmap navigators involved, it may be helpful to envision the auto-population journey with a beginning, middle, and end. At the beginning, the **Journey Leader** identifies and connects with **data holders**. **Bridge partners** can help clarify the preparation that needs to occur prior to connecting with these data holders. In the middle, the Journey Leader should determine where the solar data will be collected, cleaned, and stored before moving these data to the MLS, which is where the role of **data aggregators** is key. At the end, the Journey Leader needs support from bridge partners to provide perspective on technical requirements, user expectations, education, and consumer satisfaction. Along the way, **regulatory champions**, while not required, can serve as advocates or supporters to accelerate data access and implementation.

Journey Leaders

A Journey Leader not only recognizes the need for and value of auto-population, but also has the time and resources required to pursue an implementation strategy.



Roadmap Value for the Journey Leader

The Roadmap is written *by* Journey Leaders, *for* Journey Leaders. No other single source pulls together the needed components in a tactical, actionable way. Consider the Roadmap your initial orientation to the journey. In addition to the assessments and exercises, the Roadmap is also a valuable primer for demonstrating the value of auto-population to different audience groups.

After completing the Roadmap, Journey Leaders will be empowered to:

- Demonstrate value to the local MLS. This includes feeling confident about approaching the local real estate community, MLS, or data aggregator to establish clearly the value of solar data and present these data as an emerging product in the marketplace.
- Identify data holders.
- Understand the right questions to ask, especially as part of the assessment exercises.
- Have the necessary information and tools to determine the best pathway toward auto-population.

To assess your viability as a Journey Leader, consider the following suggested qualifications:

- The Journey Leader is part of a group or organization that has the funding, at least initially, and ability to carry the Roadmap forward.

- The Journey Leader addresses at least a metro-area footprint or perhaps a statewide footprint. This is important, because MLSs tend to have a metro-level focus, and solar data are often available at the state level.
- The Journey Leader is willing and able to understand the complex data-access and technology challenges and can work across multiple stakeholders and industries.
- The Journey Leader is within a mature or growing solar market with at least a moderately friendly government and regulatory environment.

While not all of these qualifications are required, Journey Leaders who bring these qualifications may have the most success with implementation.

Data Holders

Data holders hold the solar data in a given market.



Roadmap Value for Data Holders

Data holders will find value in reading the Roadmap for information on what elements of their data set have the potential to be shared for real estate applications. Data holders may also seek guidance from the Roadmap on how to best consider requests to share solar PV data.

After completing the Roadmap, data holders will be empowered to:

- Understand why the real estate industry is interested in automating the flow of information about solar homes.
- Identify the various stakeholders who may play a role in auto-population.
- Understand the potential benefits of sharing data with the real estate industry.
- Identify key trends and best practices toward making auto-population more feasible and secure.

- Identify the types of solar data most useful for real estate transactions.
- Know the right questions to ask in considering options to share data with the real estate industry.

Data holders vary by location, but some generalized groupings are listed below. These groups are defined in more detail in Guidepost Two: Solar Data Assessment (page 29).

- Local permit providers such as agencies that issue building or electrical permits in a town, city, or county.
- County recorders of deeds, such as those that record property liens.
- Utilities, either investor owned or publicly owned, which may collect data through incentive programs or interconnection proceedings.
- State agencies that may provide incentives for homeowners to install solar systems or oversee the process to interconnect these systems to a publicly owned utility (POU) or investor-owned utility (IOU).
- Lenders including credit unions, government-sponsored loan programs, or Property-Assessed Clean Energy (PACE) financing providers that provide solar system financing in some jurisdictions.
- Providers that manage Uniform Commercial Code (UCC) filing databases. UCC filings are recorded when a third party, such as an installer or creditor, seeks to protect its interest in the installed solar system.
- Solar installation companies.

Data Aggregators

Data aggregators already provide services to organize, match, clean, package, and share sets of data about different types of properties, and they may have the opportunity to extend into the solar market by including solar data. Alternatively, solar focused aggregators might have an opportunity to extend into the real estate market.



Roadmap Value for Data Aggregators

The Roadmap clarifies the role of data aggregators within the auto-population strategy, and it highlights a potential new business opportunity for aggregators.

After completing the Roadmap, data aggregators will be empowered to:

- Understand why the real estate industry is interested in automating the flow of information about solar homes.
- Identify key trends and best practices that are making auto-population of solar data more feasible and secure.
- Identify the types of solar data that are most useful for real estate transactions.
- Understand the interoperability issues involved in exporting, importing, or handling data for use by the real estate industry.
- Evaluate the business opportunity to extend existing solar data services to the real estate industry.

Data aggregators vary, but the following are generalized groupings:

- Tax aggregators collect public data about properties recorded by data sources such as local permit providers and local assessors. Customers for the automated feeds of these cleaned and aggregated data may include MLSs, real estate portals, and lenders.
- Nearly every residential solar installation requires a permit, typically both a building and an electrical permit. As such, a new industry of permit aggregators is emerging. These providers aggregate different types of permit data into one accessible source.
- Public or private renewable energy and energy efficiency aggregators are trying to grow awareness and opportunities for these industries by making information about energy-efficient or high-performance homes as accessible as possible to key partners.

- Other aggregator models are emerging. For example, Google—an unconventional player—is working on Project Sunroof, which uses available data sets to determine how well a solar installation might perform on a given rooftop.



Data Aggregation Companies

- Tax aggregators: Black Knight, CoreLogic, CRS Data, and The Warren Group
- Building and electrical permit aggregators: BuildZoom, BuildFax, Hot4Solar, Porch, and Construction Monitor
- Renewable energy and energy efficiency aggregators: Clean Power Finance (via PowerClerk®), Energy Sense Finance (via PV Value® and Ei Value®), Home Energy Labeling Information eXchange (HELIX), and Build it Green
- Other aggregator models: Google's Project Sunroof

Bridge Partners

Bridge partners—such as MLS operators, real estate professionals, appraisers, lenders, and underwriters—link solar data holders and aggregators with the real estate industry and, ultimately, consumers. Thus bridge partners are especially important near the end of the journey, as implementation strategies take shape.



Roadmap Value for Bridge Partners

For bridge partners, the Roadmap provides a vision of an auto-population future enabling more effective marketing, more accurate home valuation, and a more credible appraisal report. Without access to the necessary data sources, it is very difficult for real estate agents, appraisers, and others to determine the solar trends in a given market, much less extract the contributory value of solar systems. Making the data more accurate and readily available via auto-population will reduce the time agents and especially appraisers spend gathering this information.

After completing the Roadmap, bridge partners will be empowered to:

- Understand why the real estate industry is interested in automating the flow of information about solar homes and the types of players involved.
- Identify key trends and best practices toward making auto-population more feasible and secure.
- Identify the types of solar data that are most useful for real estate transactions.
- Understand opportunities for MLSs and individuals to champion auto-population.
- Know the right questions to ask in considering options to integrate data-sharing opportunities with key solar advocates and data holders.

The following provides further insight into the unique motivations of some bridge partners, helping Journey Leaders understand how they might appeal to and interact with each group.



Bridge Partner Insights

MLS Operators

MLS operators provide the property-match services that allow brokerages to cooperate on a real estate transaction in a given market. These operators deliver technology offerings under clear direction from their members. Operators can provide a Journey Leader with insights into the technical requirements for linking solar data to the MLS database.

Three key national industry groups support MLS operators in different ways:

- The National Association of REALTORS® (NAR) provides legal, governance, and anti-trust guidance for MLSs that are owned by boards of Realtors.
- The Real Estate Standards Organization (RESO) provides technical standards as well as a standard data dictionary schema for MLS data, making auto-population of data more feasible.
- The Council of Multiple Listing Services provides the industry with resources, including a directory of members who invest in best practices and tend to be the largest and most progressive MLSs (CMLS 2016a).

Real Estate Agents and Brokers

The roles of brokers and agents vary according to local state licensing laws and in practice. In the Roadmap, the terms *agent* and *broker* distinguish two levels of real estate professionals. Generally, brokers have higher licensing requirements and represent the perspective of office owners and managers. Agents work for brokers. Agents and brokerages might champion the idea of auto-population to improve efficiencies and better serve buyers and sellers. In this way, agents and brokers can help the Journey Leader position and promote some of the consumer-facing benefits of auto-population.

Appraisers

In the secondary mortgage market, lenders seeking a residential appraisal must hire appraisers who have “requisite knowledge/competency.” If the MLS or real estate portals have auto-populated solar data, appraisers can do their jobs more efficiently.

Lenders and Underwriters

Lenders benefit from appraisals that incorporate more accurate solar data, because better information reduces a lender’s risk. Underwriters mitigate lender risk by following lender guidelines to look for clear supporting details when appraisers apply values to solar systems. Thus appraisers, lenders, underwriters, and Journey Leaders can help each other as auto-population helps clarify the growing place of solar in real estate markets.

Home Builders

The Roadmap focuses on bridge partners involved with home sales and valuation. However, other entities might also have an interest in auto-population and thus become useful journey partners. Homebuilders, for example—including those associated with the U.S. Green Building Council—could advocate for auto-population, because it supports fair and consistent valuation of solar homes.

- Town/city councils or trustees
- Utility commission



Roadmap Value for Regulatory Champions

For public-sector advocates of auto-population, the Roadmap presents several specific strategies for gaining consent or access to solar data, including drafting legislation or public records requests. The Roadmap provides tactical steps and sample language that can be adapted easily by regulatory champions.

After completing the Roadmap, regulatory champions might be empowered to:

- Examine barriers to data access that exist because of laws and regulations in their local context.
- Consider possible accelerators that might allow greater access to data now or in the future.
- Organize other individuals to assist in data-access efforts.
- Agree to work with a Journey Leader to help solve data-access issues.

Regulatory Champions

Regulatory champions are individuals in the public sector who may advocate or support auto-population. Specifically, regulatory champions may help the Journey Leader with the accelerator strategies presented in Appendix A (page 62). While not every journey will require or include a regulatory champion, these individuals can be a valuable resource for some Journey Leaders. Regulatory champions may have elected, appointed, or staff roles in the following areas:

- Governor’s office
- State legislature
- County boards

Guidepost One: Landscape Assessment



This section asks the reader to identify and evaluate key landscape considerations of the solar marketplace, the implementation environment, and available resources that can help with implementation now and down the road. For Journey Leaders, the section is a call to action. Momentum can be built by researching the local context, identifying and gathering information from partners, and communicating the value of auto-population with various bridge partners.

The landscape assessment considers the following key aspects:

- **Solar marketplace assessment:** Understanding the maturity of the solar market through indicators such as number of solar installers, number and density of solar homes, and age of solar systems.
- **Implementation environment assessment:** Identifying and documenting the unique people and organizations involved, including the local MLS and the real estate community. (In some cases, Journey Leaders will work in a context supported by more than one MLS. In the Roadmap, MLS is referred to as a single or local MLS serving an area, but this context can be replicated.)
- **Connecting to local business processes:** Understanding current business processes and the opportunities and challenges in connecting solar data.
- **Preliminary journey and resource assessment:** Considering the vision, time frame, goals, and possible sources of funds to support later auto-population implementation efforts.

number of solar homes grows, so too does the number of transactions and the need for good data to value these homes appropriately. Valuation also changes as systems age or differ in size or ownership type. A Journey Leader equipped with information about their marketplace will be better positioned to make a case for auto-population.



What information to collect for the assessment: Ideally, the following solar marketplace information could be collected in a local context:

- The number of solar homes and how that has changed in the last one to two years.
- The density of solar homes compared with all residential homes by ZIP code or town.
- The names and contact information of the largest solar installers.
- The range of ages and sizes, in kilowatt-hours (kWh), of installed solar systems.
- The frequency of homeowner-owned, TPO, and PACE-financed systems.

Solar Marketplace Assessment

The value of auto-population is tied to the maturity of the solar market. The use case for auto-population is different in marketplaces with very small inventories of solar homes versus those with high inventories. As the



Where to collect information on the solar marketplace: Information on solar marketplace data can be collected from industry groups such as the Solar Energy Industries Association (SEIA) as well as DOE laboratories—see, for example, Lawrence Berkeley National Laboratory’s annual Tracking the Sun series (LBNL 2016) and the National Renewable Energy Laboratory’s Open PV Project (NREL 2016b). Information also can be collected by speaking directly with local solar installers.



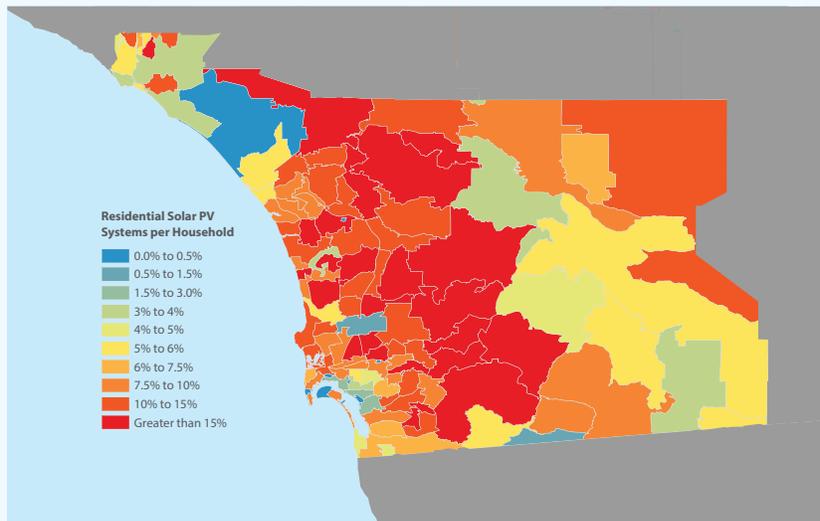
Reflections from the Road

Landscape Assessment: Solar Marketplace

Figure 1 and Figure 2 demonstrate aspects of a solar marketplace assessment for San Diego.

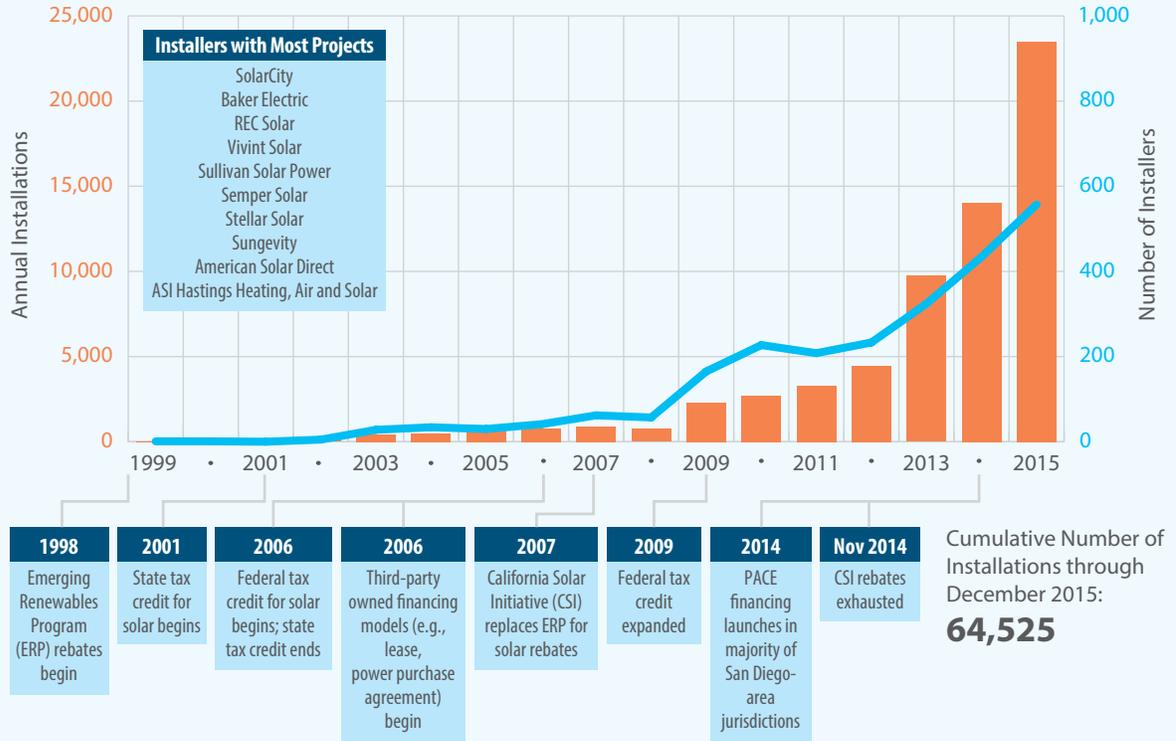
FIGURE 1

Residential Solar PV Systems per Household in San Diego County (Density by ZIP Code)



Created by Center for Sustainable Energy using Currently Interconnected Data Set, California Solar Statistics and 2010-2014 American Community Survey 5-year estimates

FIGURE 2
Single-Family Home Solar PV Market in San Diego County



Data Source: Currently Interconnected Data Set, California Solar Statistics

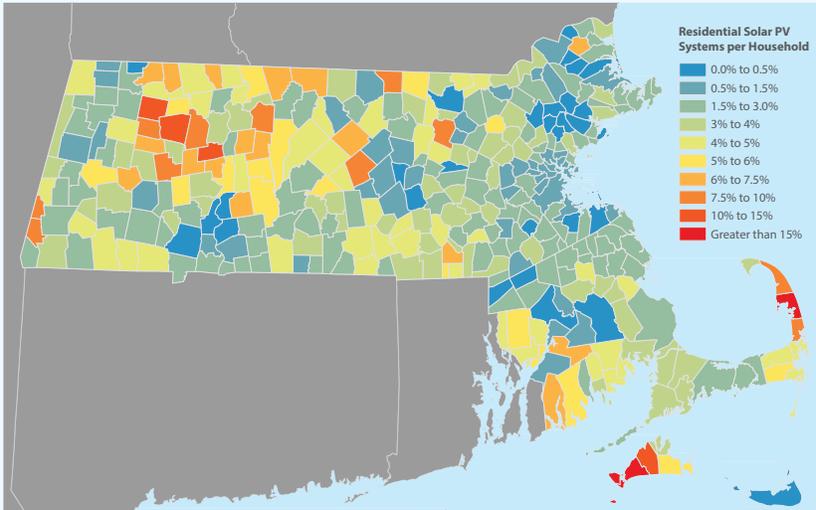


Reflections from the Road

Landscape Assessment: Solar Marketplace

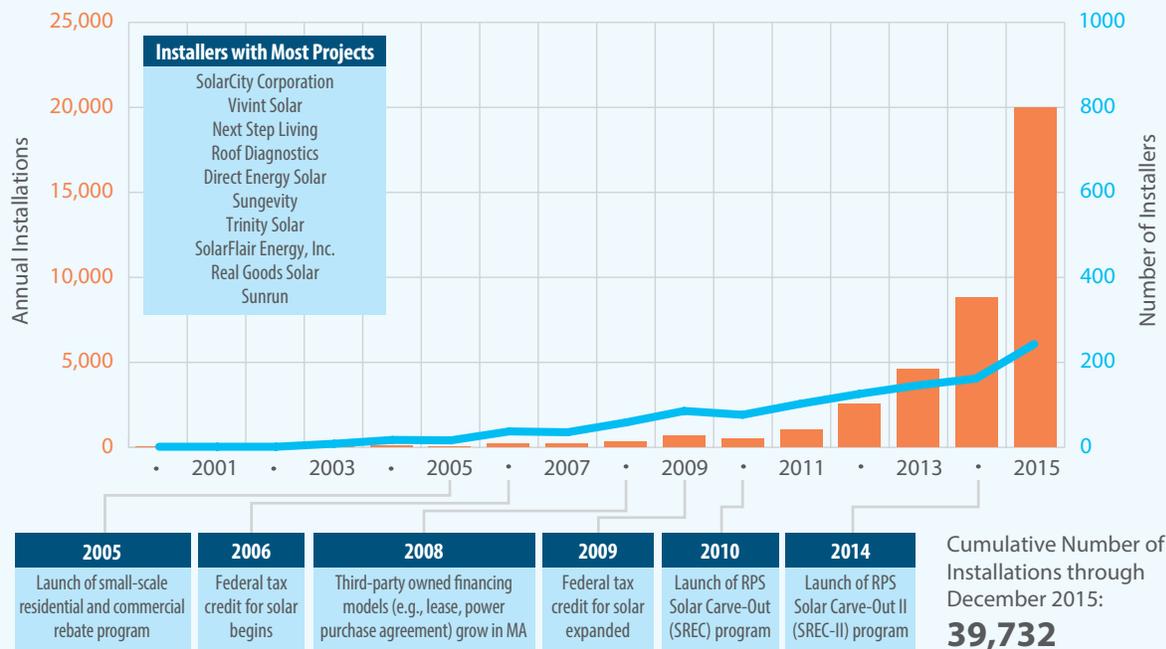
Figure 3 and Figure 4 demonstrate aspects of a solar marketplace assessment for Massachusetts.

FIGURE 3
Residential Solar PV Systems per Household in Massachusetts (Density by Township)



Source: Massachusetts Clean Energy Center Production Tracking System, August 2016

FIGURE 4
Residential* Solar PV Market in Massachusetts



*Three or fewer dwelling units
Data source: Massachusetts Clean Energy Center

Implementation Environment Assessment

Key to understanding the implementation environment is to know that every market is unique. To make sense of the intricacies, Journey Leaders can start with an assessment of the local MLS landscape and the real estate community.



The MLS Landscape

There are about 750 MLSs across the country, each independently operated and with different governance structures. Most are owned by one or more local boards of Realtors. The large majority are served by just five major software vendors, with the small minority (less than 10%) using proprietary, in-house software (Elevate Energy and NHPC). Similarly, a large majority are served by only a handful of tax aggregators.

Within the real estate *agent* community, two groupings exist—brokerages and agents—although these terms vary in practice and according to local state licensing laws. Generally, brokerages have higher licensing requirements and represent the perspective of office owners and managers. Often, MLS ownership shares and board seats are limited to brokerages only. Agents work for brokerages. While agents may source their own buyer and seller leads, they provide services on behalf of the brokerage. For this reason, brokerages have key decision-making, data ownership and privacy, and property-marketing status. Brokerages will be critical as decision-makers within an MLS when auto-population initiatives are up for consideration. Brokerages also own the listing data once an agreement exists between a seller and the brokerage office. Brokerages are ultimately responsible for marketing the property and protecting its privacy.



Agents and Brokerages: Motivations

Although agents and brokerages may advocate for auto-population to improve efficiencies and better serve buyers and sellers, they might also be vocal about their concerns. They may worry about the source of the data and who is liable for inaccuracies; some may want to limit the changes made to the listing process.



What information to collect for the assessment: Ideally, the following information could be collected in a local context:

- Local MLS(s): Name
- Size and footprint: How many members and brokerage offices does the MLS serve? Is the footprint of the MLS small (a city, town, or county), mid-sized (multiple cities, towns, or counties), or regional (a metro area)?
- Ownership and governance: Is the MLS owned by an association of Realtors (AOR) or by real estate brokerages independently? How is it governed?
- Decision-making model: Does the MLS board of directors or managers get involved directly or delegate to staff?
- Training and communication model: How does training for changes in software and data occur?
- MLS software vendor: Does the MLS run its technology systems in-house or outsource to key vendors? Which parts?
- Tax data record aggregator: Which, if any, software vendor does the MLS use? Which tax data record aggregator does the MLS use?



Where to collect information on the local MLS and the real estate community:

Information about the local MLS and the real estate community can be collected through outreach to a mix of large and small offices in the area as well as to individual agents, the MLS itself, and Realtor

boards and associations. Agents with “green” designations are published in directories provided by the NAR and EcoBroker International (EcoBroker 2016, NAR 2016a).



Reflections from the Road

Landscape Assessment: Implementation Environment

- Local MLS: MLSPIN
- Footprint: State of Massachusetts, excluding Cape Cod and the Berkshire area in the western portion of the state; covers 11 AOR areas
- Size: 33,000 members and 8,600 brokerage offices
- Ownership: Only brokerages can buy ownership shares, not AORs (207 offices hold 408 shares)
- Governance: MLS is an independent entity with its own board of directors
- Decision-making model: Ideas are vetted by staff and must be approved by the board of directors
- Training and communication model: Provided to users individually or to member offices
- MLS software vendor: None (software maintained in-house)
- Tax data record aggregator: The Warren Group



Reflections from the Road

Landscape Assessment: Implementation Environment

- Local MLS: Sandicor
- Footprint: San Diego metro area; covers three AOR areas
- Size: 22,000 members and more than 7,500 brokerage offices (brokerages that belong to more than one AOR may be counted more than once)
- Ownership: MLS is jointly owned by three AORs

- Governance: Each of the three ownership AORs has two seats on the board of directors; each AOR has one-third ownership and one-third of the vote regardless of the size of the AOR
- Decision-making model: Multi-level review process in which committees at the AORs provide input, Sandicor Technical User Group vets ideas, and then the board of directors may approve
- Training and communication model: Training occurs at AOR locations and brokerage offices. AORs may offer input, host, or coordinate
- MLS software vendor: Black Knight Financial Services – Paragon software
- Tax data record aggregator: CRS Data

In addition to the local MLS and the real estate community, residential appraisers and professional appraisal organizations can serve as bridge partners, and they may champion auto-population to serve both the marketing potential of solar as well as the valuation process. Similarly, lenders and underwriters might wish to see greater clarity in the sales, valuation, and underwriting process for solar homes.



What information to collect for the assessment:

How many appraisal offices exist in the area? How many appraisers are accredited to handle “green” assignments? For lenders, do any banks advertise as offering loans for high-performance homes, including solar upgrades? What sort of supporting details do underwriters expect related to solar systems?



Where to collect information on appraisers, lenders, and underwriters:

Information on appraisers can be collected through outreach to local appraiser professional associations such as Appraisal Institute chapters. Individual appraisers with education on “green” topics may be found in directories published by the Appraisal Institute (2016) and others. Many appraisers are also Realtors. Lending and underwriting guidelines on solar valuations are heavily influenced by government-sponsored financial entities including Fannie Mae, Freddie Mac, and FHA. More information is available through their handbooks and websites. Another resource is “Appraised Value and Energy Efficiency: Getting It Right” (Building Codes Assistance Project 2015).

Connecting to Local Business Processes

After collecting information on the local MLS and real estate community, Journey Leaders should consider the current local business processes. These include understanding: 1) the current solar home listing process, 2) the current auto-population process for non-solar data, 3) real estate portals and the current MLS data-syndication process, and 4) the solar-valuation process. These four processes are key to understanding how auto-population of solar data might work. It is also important to get a sense for appraisal practices in the market. Collecting this information will require working closely with the bridge partners described in the previous section (see page 13). The four business processes are described in more detail below.

1. Current Solar Home Listing Process

Generally, MLSs today offer few or no fields to capture information on solar systems. (However, see upcoming changes to the MLS standards noted on page 75.) Without a reliable and consistent set of fields, listing agents have often had to rely on a *remarks* field to highlight solar features. This field typically allows for a few sentences of text to promote the best features of the home in a narrative format. This is a limited work-around. Ultimately, standard and dedicated fields allow seller investments to be promoted and empower agents, clients, and appraisers to search more consistently.

Solar Listings Need Accurate Information

Without the right information on systems, buyers, real estate agents, and appraisers cannot accurately value them at the time of sale.

In July 2016, more than 500 homes were listed in the San Diego County Regional MLS with “solar panels” checked under “equipment.” Roughly two-thirds of these listings had additional comments. An analysis of the key words in a sample of 107 of the San Diego listings found that 5% noted system size, 7% noted installation year, and more than one-third mentioned ownership status (Figure 5).

Similarly, in the first half of 2016, 435 homes in Massachusetts listed with MLSPIN had “solar” noted in the comments. A qualitative key word search of the listings found that some referred to solar hot water heaters rather than solar electric (PV) systems, and they inconsistently disclosed system size, installation year, and ownership. Some actual remarks from these listings include:

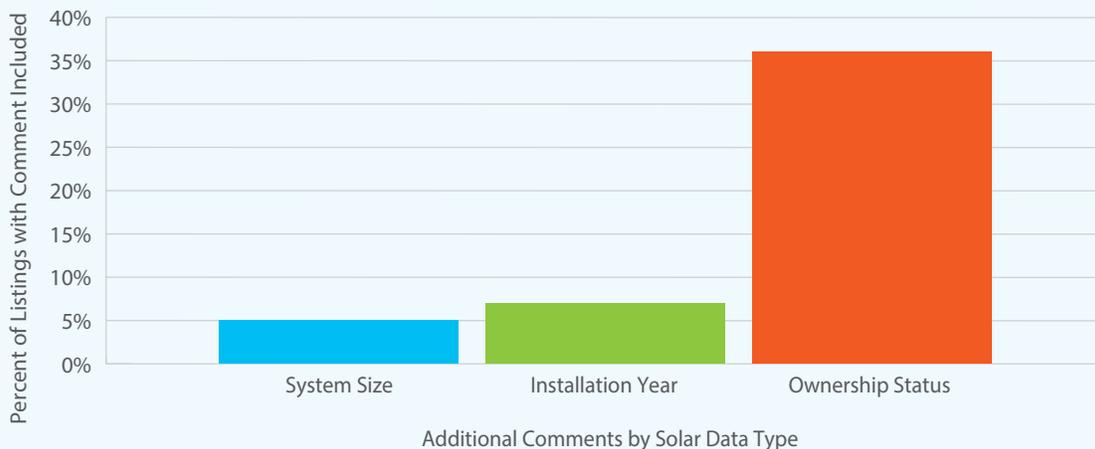
“This home also has solar panels!”

“Solar Panels: owner has not had an electric bill in months!”

“Leased Solar Panels for Affordable Energy”

FIGURE 5

Comment Topics in 107 Solar Home Listings, San Diego County



Source: Sandicor (2016)

2. Current Auto-Population Process for Non-Solar Data

While the concept of auto-populating solar data might be novel, auto-populating other data certainly is not. See the box below.

Non-Solar Auto-Population

- Tax (a.k.a. assessment) data are the most common data auto-populated to an MLS. Providers include the same tax aggregators discussed in the Roadmap Navigators section (page 11). Fields might include square footage of the property, the tax amount, and the year the home was built. Auto-population of tax data is almost always done via a licensing agreement between the MLS and the tax aggregator. The MLS usually adds “help text” that indicates the information came from public records to differentiate it from data the listing agent input directly.
- School or other census data aggregated to a ZIP code or census tract level are also common. Typically, statistics specific to the property’s area about the school and census data can be auto-populated via a hyperlink. A hyperlink is provided in the listing, and interested agents or home buyers can click to move from the listing to the data source site for a custom report.
- Walk Score uses census data aggregated to a census tract. The Walk Score rating can be from 0 (unwalkable) to 100 (“walker’s paradise”) (Redfin 2016). A supporting hyperlink can be displayed beside a numeric field, showing the nearby amenities that were considered in generating the score.
- Mortgage rates can be linked to an MLS listing in real time. Listing agents usually have the option to select a participating lender, and then a hyperlink to a real-time table of current rates is automatically displayed on the agent’s listings.

3. Real Estate Portals and the Current MLS Data-Syndication Process

In real estate, the listing process is about both presenting an accurate description of the listing and promoting that listing to as wide an audience as possible. Sharing of listing data to licensed partners is called *data syndication*. To ensure that the process is clear and fair, syndication is a collaborative effort. In this way, it also helps reflect the wishes of the ultimate owner of the data (the listing brokerage on behalf of the seller) and includes clear opt-out points. For more information on this complex topic, check [resources published by NAR](#).

Listing data are often syndicated with real estate portals. These portals—such as Realtor.com, Trulia, and Zillow—provide consumers direct access to real estate advertisements. (The potential role that portals could play in auto-population is further discussed in Appendix C, page 73.) In addition to real estate portals, individual brokerage offices might offer proprietary websites that feature their own listings as well as competitor listings.



What information to collect for the assessment: The following questions could be considered in the local context:

- What is the current method for listing solar systems?
- Are any data currently auto-populated? Which data? And how? Consider common options such as tax data, neighborhood/school data, Walk Score, and mortgage rates.
- Does the MLS direct syndicate listing data to portals? Which ones?



Where to collect information on data syndication: Preliminary information on real estate portals and data syndication can be collected by working through the MLS or agents and brokerages.



Reflections from the Road Landscape Assessment: Current Auto-Population Options

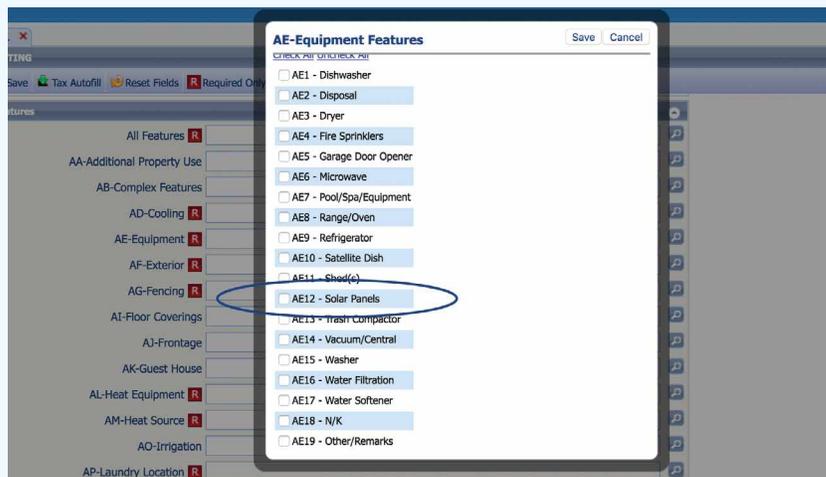
- Local MLS: MLSPIN
- What is the current method for listing solar systems?
 - ▶ One field in “Heating” is called “Active Solar,” but it is rarely checked
 - ▶ Agents mainly use remarks
- Are any data currently auto-populated?
 - ▶ Tax data: through Warren Group feed
 - ▶ Neighborhood/school data: hyperlinks are auto-populated (from National Center for Education Statistics, Maponics, and GreatSchools)
 - ▶ Mortgage rates: hyperlinks are auto-populated (from RatePlug)
- Does the MLS direct syndicate listing data to portals?
 - ▶ Zillow and Trulia: Yes
 - ▶ Realtor.com: Yes



Reflections from the Road Landscape Assessment: Current Auto-Population Options

- Local MLS: Sandicor
- What is the current method for listing solar systems?
 - ▶ A dedicated checkbox for “solar panels”
 - ▶ Details about the system can be described in the “remarks” or “supplement” section (Figure 6)
- Are any data currently auto-populated?
 - ▶ Tax data: done via custom code/application programming interface (API)
 - ▶ Neighborhood/school data: Maponics data via a data management platform between tax aggregator and Maponics
 - ▶ Walk Score: done via API
 - ▶ Mortgage rates: a hyperlink is auto-populated (from RatePlug) within a few MLS reports
- Does the MLS direct syndicate listing data to portals?
 - ▶ Zillow and Trulia: No
 - ▶ Realtor.com: No

FIGURE 6
Current Method for Listing Residential Solar Systems, San Diego (Sandicor)



Source: Sandicor residential listing input form

4. Solar Valuation Process

Appraisal and underwriting guidelines for homes with solar systems are heavily influenced by the handbooks and guidelines published by federal financing entities including Fannie Mae, Freddie Mac, FHA, and others. Tools such as PV Value and the Appraisal Institute’s *Residential Green and Energy Efficient Addendum* and *Residential Green Valuation Tools* book offer worksheets and resources to facilitate appraiser research (Figure 7 and Figure 8).

- What tools do appraisers use when valuing homes with solar systems?
- Is the underwriting process any different for these homes?



Where to collect information on the solar valuation process: Preliminary information on appraisal and underwriting practices can be collected by working through local appraisers or appraisal organizations.



What information to collect for the assessment: The following questions could be considered in the local context:

- Where do appraisers find the data needed to complete an appraisal on a home with a solar system?

FIGURE 7
Solar Data Applied During the Appraisal Process

		Beta Version 0.8.1	File #:	Appraiser Indicated Value:	\$13,800.00	\$2.30 /watt
		09/14/15 5:47:04 PM	NA	Report Prepared By:	Sandra Adomatis	
Subject Property Data						
Address: [REDACTED]						
City:	D.C.	State:	DC	Zip Code:	20011	
Property Type:	Residential	PV Project Type:	Existing	PV Ownership:	Owned	
Cost Approach Method Physical Age / Life Depreciated Cost						
Source:	User 8-1-15 DC	Gross Replacement Cost New:	\$19,800.00	\$3.30 /watt		
Life:	25	Straight Line Depreciation:	\$0.00	\$0.00 /watt/yr		
Age:	0	Accumulated SL Depreciation:	\$0.00	\$0.00 /watt		
Additional Depreciation:			None	\$ /watt		
Additional Depreciation:			Other Depreciation - All forms of loss	\$6,000.00	\$1.00 /watt	
Estimated Depreciated Value			Cost Approach:	\$13,800.00	\$2.30 /watt	
Income Approach Method Energy Value DCF						
Solar Resource		O & M Expense		Utility Rate		
System Size Watts:	6,000	Inverter Size Watts:	5,200	NREL Utility Co:	Potomac Electric Power Co	
Module Warranty Yrs:	25	Inverter Warranty Yrs:	15	NREL Utility Rate:	10.98 ¢/kWh	
System Age Yrs:	0	Inverter Age Yrs:	0	User Provided Utility Rate:	- ¢/kWh	
Remaining Yrs:	25	Inverter Replaced:	No	Utility Rate Used:	10.98 ¢/kWh	
Derate Factor:	0.77	Inverter Replacement Cycle Yrs:	15	EIA Escalation Rate:	3.90% CAGR	
Degradation Rate:	0.50%	Inverter Replacement Cost		User Provided Esc Rate:	- % CAGR	
Array Tilt:	26.6 °	Survey Data:	55 ¢/W	Escalation Rate Used:	3.90% CAGR	
Array Azimuth:	180 °	User Provided:	- ¢/W	Comments:		
Annual kWh Est:	7,139	Replacement Cost Used:	55 ¢/W	Incentives offset depreciation. Market is not willing to pay gross cost. Fed. Tax Credits are not included in incentive amount.		
		O & M Exp (future):	\$3,300.00			
		O & M Exp (discounted):	\$1,633.41			

Source: IMT (2015). Worksheet is a result of free software found at www.pvvalue.com.

FIGURE 8
Sample from Solar Page – Appraisal Institute Green and Energy Efficiency Addendum

Client:		Client File #:	
Subject Property:		Appraisal File #:	

Solar Panels						
The following items are considered within the appraised value of the subject property:						
Description	Array #1	<input type="radio"/> Leased <input type="radio"/> Owned	Array #2	<input type="radio"/> Leased <input type="radio"/> Owned	Description	Solar Thermal Water Heating System
kW (size)					If Active System - type	<input type="radio"/> Direct <input type="radio"/> Indirect
Manufacturer of Panels					If Passive System - type	<input type="radio"/> Integral collector <input type="radio"/> Thermosyphon
Warranty on Panels					Storage Tank Size	# Gallons:
Age of Panels					Collector Type	<input type="radio"/> Flat-Plat Collector

Source: Appraisal Institute (2013), printed with permission

Preliminary Journey and Resource Assessment

After gathering information about the solar market, implementation environment, and local business processes, it is time to prepare a preliminary plan. It is worthwhile to pause and consider your vision, time frame, goals, and possible funding sources. The answers may come in handy later in the journey, especially when reaching out to partners and possible initial funders.



What information to collect for the assessment: Consider and answer the following questions for your situation:

- Journey Leader: Who might serve as a Journey Leader?
- Vision: Why is auto-population important, and how might this effort fit within broader local, state, or even national efforts?
- Time frame: How much time is expected to be required to implement auto-population? What are the possible phases of the journey?
- Goals: What does auto-population look like? Be as specific as you can.

- Value to stakeholders and the Journey Leader: What is the preliminary “elevator speech,” which quickly captures the mission, goals, timing, and value proposition for different audiences?
- Potential funding mechanisms: What are possible sources of initial funds? Long-term funds? What is required to source those funds (e.g., grant applications, private underwriting, state or local budget processes)? What are limits to the period and level of possible funds (e.g., one year only, max \$10,000)? Are there options for self-sustaining funding (e.g., fees)? Journey Leaders should also note that initial visioning, scoping, and recruitment of auto-population champions may have to be completed without a clear source of funding. As the idea takes shape and more formally becomes a strategic implementation initiative, a clear definition of roles, scope, budget, funding, and time frames will be required.



Where to collect this information: Unlike the solar marketplace and implementation assessments, this is a more introspective exercise with sources and contacts unique to each initiative and location.



Reflections from the Road

Landscape Assessment: Resources

Who serves as Journey Leader: Colorado Energy Office (CEO)

Vision: MLS integration is one portion of a larger project that involves the development of a statewide distributed energy database for the purpose of storing, tracking, and providing access to data on the distributed energy systems in the state, along with energy labels such as a Home Energy Rating System (HERS) Index and Home Energy Scores.

Time frame: Effort will continue to evolve over a number of years. Foundational work began in 2011. The focus in 2016 has been on stakeholder engagement. In 2017, the focus will be on building a database and beginning outreach to jurisdictions. Outreach will continue in 2018.

Goals: The ultimate goal is to improve the state-level tracking of distributed energy systems and to increase the accessibility of distributed energy systems and energy efficiency data.

Value to stakeholders and the Journey Leader: Market analysis, local climate action, real estate valuation.

Potential funding mechanisms: CEO has built a realistic understanding of funding needs into its approach. It has maintained a multi-year vision that has helped stagger funding for the steps along the way. For example, early funding was focused on establishing standard MLS fields in the state, then education, then the gathering of an initial dataset. Now, the funding focus is on stakeholder engagement, building a database, and improving data quality. State efficiency program funds were more prominent in the early stages. Today, some state funding is being used for the initial data-gathering efforts and will be used to develop the database, MLS integration, and outreach to local jurisdictions. CEO is also incorporating extensive stakeholder input so the outcome is self-sustaining and minimizes any long-term role for the state in ongoing operations.

Early journey navigation teams envision several possible solar auto-population funding opportunities:

1. **Initial funding:** For upfront funding, Journey Leaders might use a combination of funding from utilities (efficiency portfolio funds), state efficiency program funds (often layered over multiple years), funding from foundations, and, potentially, federal sources (e.g., the DOE).
2. **Private funding:** In some cases, a private enterprise such as a data aggregator might recognize a business opportunity and create a new revenue source to aggregate and sell data to existing subscribers (such as an MLS). In this case, the private market might invest and then willingly accept assistance in putting together plans.
3. **Long-term public funding:** Finally, in other cases where the opportunity for private enterprise does not exist but there is a clear need for a solution, a large publicly funded effort might be possible, which will likely include funds to formulate an auto-population strategy. Examples of this include the HELIX project (see page 53) and the Orange Button Initiative (see page 9). This may require additional fundraising efforts for ongoing operation.

Journey Leader Exercise: Landscape Assessment



As part of the Roadmap, Journey Leaders or other readers should complete a local landscape assessment for each section of the Guidepost. Use these guiding questions as a starting place to complete the worksheet.

Solar Marketplace

- The number of solar homes and how that has changed in the last one to two years
- The density of solar homes compared with all residential homes by ZIP code or town
- The names and contact information of the largest solar installers
- The range of ages and sizes in kWh of installed solar systems
- The frequency of homeowner-owned, TPO, and PACE-financed systems

Implementation Environment

Local MLS: _____ Decision-making model: _____
 Size: _____ Training and communication model: _____
 Footprint: _____ _____
 Ownership: _____ MLS software vendor: _____
 Governance: _____ Tax data record aggregator: _____

Also consider exploring the roles of appraisers, lenders, and underwriters. How many appraisal offices exist? How many are “green” accredited? Do banks offer loans for solar upgrades? What supporting documentation do underwriters expect?

MLS Data Syndication Process

Local MLS: _____ Does the MLS direct syndicate listing data to portals?
 Current method for listing solar systems: _____ Zillow and Trulia
 Are any data currently auto-populated? Realtor.com
 Other
 Tax data
 Neighborhood/school data
 Walk Score
 Mortgage rates
 Other

Solar Valuation Process

Where do appraisers find the data needed to complete an appraisal on a home with a solar system? _____
 What tools do appraisers use when valuing homes with solar systems? _____
 Is the underwriting process any different for these homes? _____

Preliminary Journey and Resources

Who might serve as Journey Leader: _____ Value to stakeholders and the Journey Leader: _____
 Vision: _____ _____
 Time frame: _____ Potential funding mechanisms: _____
 Goals: _____ _____

Guidepost Two: Solar Data Assessment



This section helps Journey Leaders recognize the best solar data for auto-population. It identifies three categories of solar data and the typical holders of each, and it touches on data privacy and access issues. Journey Leaders should strive for access to private data or commit to a process of aggregating and cleaning public data.

Defining the Data

One aspect of the auto-population journey may be easier than the others: knowing what sort of data is most essential for real estate transactions. This is because RESO, being aware of growing inventories as well as the specialized data required to support solar home transactions, has updated the data dictionary standard used by MLSs to include a core set of standard data fields for solar systems (see text box).

While the Journey Leader does not need to be a RESO expert to conduct a solar assessment, it is critical to create a RESO-compliant solution for all auto-population efforts. Bridge partners on the real estate side are most likely promoting RESO-compliant solutions. The more familiar a Journey Leader is with the standards the more fast-tracked activities will be later. RESO's developer information page is a great place to learn more about this in-depth topic (RESO 2016a).

Standardizing MLS Solar Field Definitions

Imagine you are ready to buy a home. You recognize the value of solar energy and wish to search for homes with solar systems. You go online and search by the size of a solar system the same way you can search for homes by price or number of bedrooms—fast, simple, and effective.

While this capability will not materialize overnight, RESO has taken key steps in that direction. Right now, property data of all types differ from market to market. To help resolve this, RESO created a

Data Dictionary—a “Rosetta Stone” for the real estate industry—that standardizes property data fields across the country.

Effective July 2016, RESO incorporated standard fields to describe solar and other renewable energy systems in Version 1.5 of its Data Dictionary. Going forward, MLSs that offer fields for solar systems must comply with the dictionary definitions to be compliant with the industry standard.

To encourage adoption of these standard fields across MLSs, RESO has embarked on a multi-year certification effort. Five different Data Dictionary certification levels for MLSs—Core, Bronze, Silver, Gold, and Platinum—will go into effect in five waves, with the first deadline completed January 1, 2016, and continuing through 2020. Solar fields will be part of the Silver wave required for industrywide adoption by January 1, 2018, but MLSs can—and many will—implement sooner.

The RESO-compliant fields that could be auto-populated are as follows:

- The address where the solar system is installed
- The type of ownership for the system
- The size of the system
- The year the system was installed
- The actual or estimated annual system output
- The source of the data

Some data fields, such as address and year installed, are self-explanatory. Other items require more explanation (see the box below). Appendix D provides an overview of the technical description of these fields as well as the requirements for MLSs to implement. The fields are also defined in the RESO Data Dictionary version 1.5 (RESO 2016b).

Detailed Description of RESO Compliant Solar Fields

The type of ownership indicates whether the system is owned by the homeowner or by a third party, for example, via a lease or power purchase agreement (PPA). It must be very clearly defined. Ownership may impact how the system is marketed, its value, whether or not (and how) it will be transferred from seller to buyer, and what procedures the appraiser must follow. Systems owned by the home seller are typically considered *real property* and transfer with other real property. Systems leased or covered by a PPA are typically considered *personal property*, and additional steps are required to transfer the system. Often a UCC filing is made when the system is TPO. The filing records that the third party owns this solar system (personal property) and therefore restricts its transfer in a sale until that claim is resolved. Fannie Mae and other secondary lenders might also treat owned, leased or PPA systems differently, possibly applying different valuation guidelines.²

The size of the solar system indicates how much power the system can generate at any given moment when the sun shines on it. Size is measured in units of kilowatts (kW) direct current (DC).

Actual system production is based on real production of electricity over the previous months or years. It is measured in kilowatt-hours (kWh) produced in an average year.

Estimated system production may predict how much electricity the system will produce in one

year based on the characteristics provided, and is measured in kWh per year. This might be used when actual system production is not available. A partial estimate may also be provided using any actual production recorded for less than a full year, blended with predicted production for the rest of the year based on available static characteristics.

Source of data indicates the origin of the data that are auto-populated. Knowing the source enables the parties involved to investigate further if needed.

The RESO compliant data fields for auto-population fall into two distinct categories: *static data* and *actual production data*. These categories are important to understand, because access and privacy considerations vary for each.

Static data about a solar system rarely or never change over time. As a point of comparison, a home's static data may include the year the home was built, the style, and if it has a basement. Some static data are easily confirmed with the naked eye and by an untrained expert or might be recorded on a permit or other documentation. For a solar system, static data may include address, ownership type, size, and year of installation. *Estimated* production is also considered static because it is derived from the static characteristics.³

In contrast, *actual production data* is a variable characteristic that changes over time. For a home, other variable data includes historical water or electricity use. For a solar system, the system's historical electricity generation constitutes the *actual* production data. Environmental influences such as weather and shading, as well as maintenance of the system can have a large effect on the actual level of system production, and therefore it can differ substantially from *estimated* production.

Actual production data are helpful. More production means lower electricity bills for the property, potentially even revenue via selling excess electricity to the grid, and, in some locations, might also determine solar renewable energy credits (SRECs). Therefore, the value of the

² When securing a Fannie Mae mortgage loan on a solar property, a solar lease might be viewed differently than a PPA. If the system is a lease, the solar lease payment might be included in the expense side of the debt-to-income ratio, whereas a PPA payment for energy would not be included there. See Fannie Mae Selling Guide (2016) for more information.

³ Estimated solar production is primarily derived using the system size, age and the location of the home, but also the tilt and azimuth of the roof on which it is installed might be taken into account. System age is important because production will degrade over time, but only by less than one percent per year.

system is strongly tied to its production. However, actual production data also introduce a host of challenges for auto-population, including the following:

- Actual production data are often private to the homeowner, the private company that installed the system, the lease or PPA provider, or the utility. Access to these data may require an entirely different path to confirm they can be shared with an MLS or others.
- Production data from one year might misleadingly imply the same continued level of production in subsequent years. Ideally, data would be collected over more than one year and averaged.

Can the information be verified?

MLSs are in the business of providing the fullest and most accurate information possible, and they strive to protect their members from liability related to inaccurate or misleading information. Therefore, an MLS tends to be more interested in using data that can be verified with the naked eye or via easily accessible paperwork. The users of MLS data—real estate agents and appraisers—are equally keen on verified information.

The Public-Private Paradox of Solar Data

When a homeowner installs a solar system, it might be one of the most noticeable home improvements possible. Solar panels are usually visible from the street, and they can even be viewed using online applications like Google Earth (Figure 9). Additionally, an extensive paper trail usually exists for solar systems. The installer typically needs to obtain building and electrical permits, and most homeowners file for permission to connect to the grid, a process that includes an application and sometimes a public hearing because the grid is a public asset. Finally, solar system purchases are sometimes financed, and the lender or installer often secures the loan with a lien against the property via a UCC filing recorded as a public record at the county registry of deeds on the property.

Given the multitude of records for residential solar systems, many of which are created through public processes, it might seem easy to make those data available to an MLS—but it is not. Early Journey Leaders investigating the landscape to help write this Roadmap have encountered this *public-private paradox of solar data*: although much information about a residential solar system may be visible or publicly accessible, the record or key parts of it may

FIGURE 9

Google Earth Image of a Solar Rooftop, Visible to Public (Online)



Source: Google Earth

be protected and private, and it is often very difficult to retrieve—see the text box below as well as the following Guidepost on data access.⁴



Public or Private Data?

Here is where the solar records paradox gets complicated for the Journey Leader. Often publicly recorded data, such as permits and UCC filings, are not complete. All too commonly, individual records exist, but fields do not include all the MLS target information, because they are not consistently completed or they use different units of measurement. Also, the data collected in one jurisdiction may not be recorded the same way in another jurisdiction. All these factors make aggregation difficult. Further, these records sometimes do not include quality control on the accuracy of the data filed. On the other hand, privately collected data usually have a fuller set of MLS fields represented, are organized in aggregate files or databases, and include a quality-control review process. Therefore, one of the Journey Leader's main tasks will be to figure out how to access private data or how to aggregate and clean public data.

Who Holds the Data?

Data holders may operate nationally or within a specific coverage area. Typically, there are multiple data holders in a given area, each collecting a slightly different set of data on solar homes and each with different authorizations or comfort levels about how much data can be shared and with whom. Below and in Table 1 are described the three categories of solar data based on ownership: publicly recorded data – property-specific, publicly recorded data – anonymized, and non-public data.

Publicly recorded data – property-specific: Data for a specific address are recorded with an associated filing and publishing process, including getting a permit and recording a lien.

4 In California, records containing most data collected via the interconnection process are released to the public on a per-system basis, but the address is redacted, so matching to the MLS records is impossible (see Go Solar California 2016).

- **State and local permitting agencies** collect data for building and/or electrical permits, which are required for most solar installations.⁵ Permit data are public records but are often not collected completely or consistently. To find the local permitting agency, search online using “permit” plus the town or city name.
- **UCC filing database providers** include large national subscription databases such as First American, CT Lien Solutions, and Lexis Nexus as well as local sources such as the county recorder. UCC filings often indicate if a system is owned by a third party.⁶ UCC application data are often not collected completely or consistently.

Publicly recorded data – anonymized: Some data have a filing and publishing process, but the published records have the property address redacted. Interconnection data—which are generated during the process⁷ of a solar system being approved to participate in NEM—usually fall into this category. Much of these data are collected by utilities, the majority of which are IOUs (see text box and Figure 10). Journey Leaders should investigate which utility model operates in a particular area, and what its data-collection processes are, how it is regulated, what is its process for changing rules and tariffs. Industry reports are a good place to start, including the *State Energy Efficiency Scorecard* (ACEEE 2015) and *50 States of Solar* (NCCETC 2016b).

- **POUs** are created by charter and owned by local jurisdictions like a city.⁸ The POU is owned by the

5 Local governments often have jurisdiction over the building permit process, because state governments have delegated most land-use planning functions to the local level. In Vermont, building permits are filed with the local government, whereas electrical work notices are filed with the State Department of Public Safety (Vermont Department of Public Safety 2016). In Boston, building and electrical permits are filed with the Boston Inspectional Services Department.

6 Companies that have historically only provided third-party ownership are moving into having the homeowner own the system with third-party financing. This would still trigger a UCC filing, but the type of ownership might not be differentiated on the filing.

7 The interconnection process is typically overseen by a state or local agency. The interconnection standards address technological, legal, and procedural requirements and must be followed by consumers and utilities. Processes vary, but may include an application as well as a public notice and comment period. Applications may be published when a public comment process is available and therefore may set a precedent for these solar data to be publicly shared.

8 The electricity coverage area may include all of, part of, or less than the same footprint as the governing jurisdiction depending on how the POU is established.

governing jurisdiction and subject to public control and regulation. POU that provide electricity might collect data on the interconnection between the individual residential solar system and the utility and/or systems incentivized by rebate programs under their administration. The American Public Power Association publishes a list of the 100 largest electric POU (APPA 2016).

- **IOUs** are private corporations that provide electricity and/or natural gas. IOUs are typically regulated by public utility commissions in each state in which they operate. Like POU, IOUs might collect data on the interconnection between the individual system and the utility and/or systems incentivized by rebate programs under their administration. The Edison Electric Institute is one industry group for IOUs, and it provides a list of member organizations and coverage areas (EEI 2016).
- **Electric cooperatives** are private, independent, member-owned utilities that primarily serve small and rural areas. Cooperatives operate on a not-for-profit basis providing cost-of-service electric power to their members. Depending on the state, electric cooperatives may be self-regulated or regulated by state public utility commissions. The National Rural Electric Cooperative Association maintains a list of members in each state (NRECA 2016).
- **State agencies** may also keep data on solar systems.⁹ Often this is to oversee the process to

interconnect these systems to a utility or to track incentive programs that encourage homeowners to install solar systems.¹⁰ Government agencies might consider residential records public in the case of residential solar users who receive public incentive funds. One option for gaining access to data is to change incentive application forms so they enable recipients to give consent to share their solar data (see Appendix A, page 62).

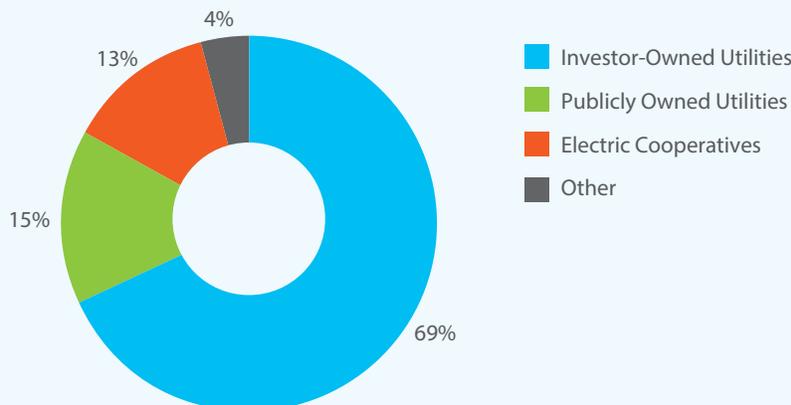
Utility Models

About 70% of utility customers served nationally are served by IOUs, and the rest are served by POU, cooperatives, or other types (Figure 10). In Massachusetts, for example, three IOUs cover 85% of consumers and are overseen by the Massachusetts Department of Public Utilities (DPU). The other 15% of consumers are served by about 40 municipal or cooperative utilities.

⁹ The National Association of State Energy Officials includes many such state agencies among its membership.

¹⁰ For example, a state may adopt an energy portfolio standard that requires that utilities increase energy efficiency or add more renewables to their generation mix by purchasing generation from third parties. To achieve these goals, states often adopt laws offering rebates or tax credits and sometimes streamlined permitting processes that reduce the economic barriers to installing solar. For examples of what local governments can do, see DOE’s guide for local governments (DOE 2011), some of which might be happening in the Journey Leaders locale. To understand the incentives available in a given market, see the Database of State Incentives for Renewables and Efficiency (DSIRE) (NCCETC 2016a).

FIGURE 10
Proportion of Customers Served Nationally, by Utility Type



Source: APPA (2015)

Non-Public Data: Solar installer companies or lenders and other businesses may keep their own private data.

- **Residential solar system installers** include large regional and national installers (such as SolarCity, Vivint Solar, SunPower, Sungevity, and Sunnova), local installers (of which there are thousands), and a few equipment manufacturers such as Enphase and SolarEdge. These companies may install systems for purchase, lease, and/or PPA. Industry groups,

such as the Solar Energy Finance Association (SEFA) or SEIA, do not hold the data but might facilitate connections to the companies that do. A sample list of large solar installation companies is published on the SEIA membership directory page (SEIA 2016a).

- **Lenders** include credit unions, low-interest-rate government programs, and PACE providers. Examples of credit unions with solar loan programs include

TABLE 1
Typical Characteristics of Solar Data Files, by Source

Source	Data	Typical Data Format	Typical Data Updates	General Data-Quality Notes
Publicly Recorded Data – Property-Specific				
Local permitting agencies	Permits	Individual records: may be paper based, others in database	Varies; may be weekly, monthly, or quarterly	Varies; permit process is to protect on-site safety and is typically not focused on verifying system characteristics
UCC filing database providers	UCC filings	Electronic images (i.e., PDFs), individual records in online database (may be paper based)	Varies; may be weekly, monthly, or quarterly	Varies; some lenders might not file, while others might file standard forms in some jurisdictions and proprietary forms in others
Publicly Recorded Data – Anonymized				
POUs and IOUs	Interconnection applications	Database extract	Varies; may be weekly, monthly, or quarterly	Varies; may accept what installer enters with no cross-check or could be cross-referenced to incentive application
State agencies	Incentive program data	Database extract	Varies; may be weekly, monthly, or quarterly; updates could stop if incentive program ends	Varies; may accept application data with no cross-check or could be cross-referenced between incentive and interconnection data
Non-Public Data – Private Market				
Lenders	Financing data	Private; unknown	Private; unknown	Private; unknown
Solar system installers	Installer data	Private; unknown	Private; unknown	Private; unknown

San Diego Metropolitan Credit Union (SDMCU 2016) and Point Loma Credit Union (PLCU 2016). Incentive loan programs include Mass Solar Loan (2016). PACE is a secured loan, often used to fund solar installations, that attaches to the property as a voluntary assessment on the property taxes. A state, city, or county must pass a resolution to participate in a PACE program, and PACE financing is often a partnership between a private finance company

and a public agency. PACE data are private to the financing providers. However, because of the public nature of PACE, as new programs are rolled out, local governments might specify that data on systems financed through the program be made available for auto-population.¹¹ PACE provider examples include Renovate America and Ygrene Energy Fund. PACENation (2016) provides an online membership directory.



Reflections from the Road

Solar Data Assessment

As a county-level example, here is an assessment of the local data source environment in San Diego.

Information about the data			Data available for auto-pop fields?					
Data Source	Data	Public or Private?	Address of Solar Home	Ownership/ Financing Type	Size of System	Year Installed	kWh/ year Estimated	kWh/ year Actual
Publicly Recorded Data – Property-Specific								
Local Permitting Agencies	Permits	Public	Yes	No	Varies	Yes	No	No
UCC Filing Database Provider	UCC filings	Public, available for fee	Yes	Yes	No	Yes	No	No
Publicly Recorded Data – Anonymized								
IOUs or State Agency	Interconnection applications	Public, address redacted	No	Yes	Yes	Yes	No	No
IOUs or State Agency	Incentive program data	Public, address redacted	No	Yes	Yes	Yes	No	No
Non-Public Data – Private Market								
Lenders	Financing data	Private	Yes	Yes	Yes	Yes	Unknown	Unknown
Solar System Installers	Installer data	Private	Yes	Yes	Yes	Yes	Yes	Varies

¹¹ Residential PACE programs for solar currently exist only in California, Connecticut, Florida, Missouri, New York, and Rhode Island. The market is rapidly evolving and expanding, and local policymakers might think about auto-population implications when designing new or modifying PACE programs to address data-sharing opportunities upfront, such as confirming consent is granted to share data.



Reflections from the Road

Solar Data Assessment

As a state-level example, here is an assessment of the local data source environment in Massachusetts.

Information about the data			Data available to be entered in RESO fields?					
Data Source	Data	Public or Private?	Address of Solar Home	Ownership/ Financing Type	Size of System	Year Installed	kWh/ year Estimated	kWh/ year Actual
Publicly Recorded Data – Property-Specific								
Local Permitting Agency or Local Assessors	Permits	Public	Yes	No	No	Yes	No	No
UCC Filing Database Provider	UCC filings (only TPO)	Public	Yes	Yes	No	Yes	No	No
Publicly Recorded Data – Anonymized								
Interconnection Data	Interconnection applications	Private	Yes	Yes	Yes	Yes	No	No
State Agency	Incentive program data	Public, address redacted	No	Yes	Yes	Yes	No	Private
Non-Public Data – Private Market								
Lenders	Financing data	NA	Residential PACE financing currently not available in Massachusetts					
Solar System Installers	Installer data	Private	Yes	Yes	Yes	Yes	Yes	Yes



Reflections from the Road

Solar Data Assessment

As a state-level example, here is an assessment of the local data source environment in Colorado.

Information about the data			Data available to be entered in RESO fields?					
Data Source	Data	Public or Private?	Address of Solar Home	Ownership/ Financing Type	Size of System	Year Installed	kWh/ year Estimated	kWh/ year Actual
Publicly Recorded Data – Property-Specific								
Local Permitting Agency or Local Assessors	Permits	Public	Varies	No	Varies	Varies	No	No
UCC Filing Database Provider	UCC filings (only TPO)	Public	Yes	Yes	No	No	No	No
Publicly Recorded Data – Anonymized								
Interconnection Data	Interconnection applications	Private	Yes	Yes	Yes	Yes	No	No
State Agency	Incentive program data	Private	Yes	Yes	Yes	Yes	No	No
Non-Public Data – Private Market								
Lenders	Financing data	NA	Residential PACE financing currently not available in Colorado					
Solar System Installers	Installer data	Private	Yes	Yes	Yes	Yes	Yes	Yes

Journey Leader Exercise: Solar Data Assessment



As part of the Roadmap, Journey Leaders should complete a solar data assessment. Use the template below as a starting place to assess the data sources in your local context.

Information about the data			Data available to be entered in RESO fields?					
Data Source	Data	Public or Private?	Address of Solar Home	Ownership/ Financing Type	Size of System	Year Installed	kWh/ year Estimated	kWh/ year Actual
Publicly Recorded Data – Property-Specific								
	Permits							
	UCC filings							
Publicly Recorded Data – Anonymized								
	Interconnection applications							
	Incentive program data							
Non-Public Data – Private Market								
	Financing data							
	Installer data							

Guidepost Three: Data-Access Assessment



Whereas the previous section focuses on identifying solar data and data sources, this section helps Journey Leaders understand and address the barriers to accessing the desired data in a local context. It introduces six “barrier busters” that could help Journey Leaders overcome data-access challenges down the road.

Data-Privacy Barriers

Striking a balance between the protection of customer privacy and the accessibility of key solar data is critical to implementing auto-population and supporting an informed free market for solar homes. Today, however, the deployment of rooftop solar is outpacing the adoption or amendment of laws and regulations addressing data access and the data-privacy concerns of government agencies, utilities, and customers. Journey Leaders need to understand the privacy-related data issues so they can implement ways to overcome them. Many state laws are based on federal statutes (see box to the right).

Journey Leaders can learn much about a state’s prevailing privacy perspective by assessing the utilities. Utilities are a major source of high-quality, accurate data collected from customers seeking to interconnect to the grid. However, utilities view themselves as *guardians* of the data, not owners of it. They consider the customer to be the data owner, a viewpoint that is increasingly becoming the industry standard. The utility can collect and use the data for a limited subset of primary purposes (such as billing and maintenance) without obtaining customer consent. Any other use of the data is secondary, which requires customer consent.

Barriers to solar data access also arise from similar treatment of different types of data. For example, multiple states are working on grid-modernization plans to facilitate smart-meter integration, and the trend is toward increasing restrictions on customer data. The data-protection protocols being created under grid-modernization dockets are designed for electricity-consumption data from smart meters. Such consumption data reveal behavior patterns and thus are more susceptible to misuse than solar

production data. Unfortunately, both consumption and solar data are being treated equally and require consent from utility customers. Therefore, utilities and public service departments often only make data available in aggregated or anonymized formats.

Examples of Federal Privacy Laws

Federal development of data-privacy statutes, regulations, and policies has influenced the state privacy laws that are the focus of the Roadmap. For example, the Federal Privacy Act of 1974 contains general privacy provisions that are the basis of the Department of Homeland Security Fair Information Practice Principles list. It provides for the use of personally identifiable information by applying principles of transparency, individual participation, purpose specification, data minimization, use limitation, data quality and integrity, security and accountability, and auditing. Some of those provisions have been incorporated into state privacy laws.

Another example is DOE’s Data Guard program, formerly known as the Voluntary Code of Conduct, for protecting consumer data including data generated by smart-grid technologies. The standards, released in January 2015, were developed in partnership with the Federal Smart Grid Task Force, which was created under Title XIII of the Energy Independence and Security Act of 2007. At the state level, the standards are often considered in grid-modernization efforts. Journey Leaders should be aware of Data Guard if they intend to lobby their state government or petition a state agency.

The reflections below provide examples of data-privacy issues encountered in real situations, along with other types of barriers mentioned in Guidepost Two. Following those reflections, a template helps Journey Leaders start their own data-access assessment. Finally, this section concludes with an introduction to strategies for accelerating access to solar data.



Reflections from the Road

Data-Access Assessment

As a state-level example, here is an assessment of the data-access landscape in Massachusetts.

What data?	What prevents the MLS from having access today?	What helps to allow MLS access today?
Permits	Only data point available today is year of installation.	The Warren Group already pulls permit data, could add solar.
UCC filings	Only data point available today is ownership type.	The Warren Group already pulls UCC data, could add solar.
Interconnection applications	These are privately held by the utility.	
Incentive program data	These are privately held by the program data administrator.	The program data administrator agrees that having solar data in the MLS would be a consumer benefit.
Financing data	Residential PACE financing is not available in Massachusetts.	
Installer data	There are approximately 240 individual installers in Massachusetts. Currently there is no consolidation.	Top 10 installers constitute 74% of the installations therefore it is reasonable to source from them.



Reflections from the Road

Data-Access Assessment

As a state-level example, here is an assessment of the data-access landscape in Colorado.

What data?	What prevents the MLS from having access today?	What helps to allow MLS access today?
Permits	There are 64 counties and around 300 permitting jurisdictions with no common permitting practices. Data are not consistent, comprehensive, or consolidated.	
UCC filings	Central state database has very limited information.	Could be used to confirm third-party ownership.
Interconnection applications	These are privately held by the utility.	
Incentive program data	Both state and utility rebate data are private and protected by data-privacy rules.	
Financing data	Residential PACE financing is not available in Colorado.	
Installer data	Data are privately held by installers and there are too many to source from directly.	

Journey Leader Exercise: Data-Access Assessment



Use the worksheet template below as a starting place to assess the data-access landscape in your area.

What data?	What prevents the MLS from having access today?	What helps to allow MLS access today?
Permits		
UCC filings		
Interconnection applications		
Incentive program data		
Financing data		
Installer data		



Accelerating Access to Solar Data

Clearly there are no easy, one-size-fits-all solutions to data-access challenges, but a number of strategies can be useful when tailored to a Journey Leader's local context. One highly effective approach is collaboration with a public-sector regulatory champion who can help overcome key roadblocks (see page 15). With or without such a champion, however, Journey Leaders could consider use of the following data-access accelerators, or "barrier busters," which are detailed—along with sample forms and other supplementary information—in Appendix A.

Barrier Buster I: Opt-In/Opt-Out Consent (see page 62)

In collaboration with data holders, Journey Leaders or others can develop an opt-in/opt-out option to gain consent for data. Opt-in consent requires an affirmative choice from customers to share their data. Opt-out consent creates a default setting in which all customers agree to share their data unless they choose not to participate in the data-sharing program. In any case, this is a multi-step strategy that requires contacting the homeowner or customer via a communication piece, such as a postcard.

Recommended application: Use this barrier buster to make historical data available for auto-population from homeowners who have already installed a solar system.

Barrier Buster II: Contract Consent Clauses (see page 64)

In the process of installing a solar system, a customer must sign multiple agreements, such as those related to interconnection registries, incentive programs, financing, and system installation. Each agreement represents an opportunity to insert a consent clause that allows the customer to opt in or out of data sharing.

Recommended application: Use this barrier buster to gain access to new customer data.

Barrier Buster III: Draft Legislation (see page 64)

Legislation can be created or amended to allow the collection, disclosure, and access to historical and/or

future customer data. Potential legislative targets include state privacy laws, public records laws, state public utility commission regulations, and local and state government agency functions. The process is lengthy but has the potential to create broader access to a large set of data.

Recommended application: Use this barrier buster if there is strong commitment for fundamental change and financial budget to support legislative action.

Barrier Buster IV: Public Records Request (see page 66)

If a public-sector data holder cannot be engaged in a more informal manner, an official records request could be used to gain access to government-collected solar data that are not specifically exempted from disclosure to the public. In making such a request, it is important to understand and follow the application process fully.

Recommended application: Use this barrier buster if there is strong stakeholder commitment to fundamental change and financial budget to support potential legal activities.

Barrier Buster V: Best Practices for Local Governments (see page 68)

Local governments may be able to influence how permitting and PACE programs are designed and administered. Regulatory champions and/or Journey Leaders can work with these governments to advocate for program planning, design, or operations that promote auto-population of solar data.

Recommended application: Use this barrier buster to update the process for building and electrical permits to ensure essential auto-population fields are collected consistently. It can also be applied as new local PACE jurisdictions are created to define the essential fields that approved financing providers might be required to share.

Barrier Buster VI: Using Data Mashups to Increase Volume of Solar Data Available (see page 68)

A variety of partial data sets are typically available, such as permit data without all the desired solar data, UCC filings, interconnection and incentive data without addresses, and private (e.g., Google Map) solar location data without system details. Journey Leaders might be able

to encourage innovations that use probabilistic techniques to match data from various partial sources to create more comprehensive property records for auto-population.

Recommended application: Apply this barrier buster in collaboration with partners—such as city staff, local university professors and graduate students, or other technology innovators—who have the technical capabilities to assist with the required matching procedures.

Figure 11 suggests which barrier busters apply to the various types of solar data, and it notes the best possible outcome and measurable impact of each. The subsequent reflection shows examples of how the barrier busters might be applied in specific areas.

The reflections below are provided as examples based on current challenges and most likely opportunities in each area.

FIGURE 11
Barrier Busters Applicable to Various Data Types

What Data?	Barrier Buster to Consider	Best Possible Outcome	Measurable Impact
Permits	V: Best practices for local governments	Update existing or start new solar permit process aligned to RESO standard	Increased quantity of fields to auto-pop, improved quality of data
	VI: Data mashup	Combined data set that contains a comprehensive set of fields	Increased quantity of records to auto-pop
UCC Filings	VI: Data mashup	See Permits above	
Incentive Program Data Interconnection Applications	I: Opt-in/opt-out consent	Consumer consent to publish	Database of records to auto-pop
	II: Contract consent clauses		
	III: Draft legislation	Entity (utility, agency, etc.) is permitted or required release records in bulk	
	IV: Public records request		
	VI: Data mashup	See Permits above	
Financing Data	I: Opt-in/opt-out consent II: Contract consent clauses	See Incentive/ Interconnection above	Database of records to auto-pop
	V: Best practices for local governments	Update existing or start new financing program for which participating lenders are permitted or required to release records in bulk	
Installer Data	I: Opt-in/opt-out consent	See Incentive/ Interconnection above	Database of records to auto-pop
	II: Contract consent clauses		



Reflections from the Road

Barrier Buster Assessment

What data?	Barrier buster to consider	What might help in CO?	What might help in MA?	What might help in San Diego?
Permits	V: Best practices for local governments	State could encourage municipalities to update solar permit processes		
Permits	VI: Data mashup		Local innovators could match permits to other data.	
UCC Filings				
Interconnection Applications				
Incentive Program Data				
Incentive Program Data	I: Opt-in/opt-out consent			Postcard campaign for consumer consent
Financing Data	V: Best practices for local governments	If residential PACE were to be introduced, look at establishing participating system characteristics as public data		
Installer Data	II: Contract consent clauses			Updated contract language led by the established market base

Journey Leader Exercise: Barrier Busters



As part of the Roadmap, Journey Leaders should complete an assessment for each section of the Guidepost. Based on the previous data-access assessment, think through what barrier buster strategies might be available. Consider the best possible outcomes and measurable impact for each strategy input.

What data?	Barrier buster to consider	What barrier buster initiative might help?
Permits	V: Best practices for local governments	
Permits	VI: Data mashup	
UCC Filings		
Interconnection Applications		
Incentive Program Data		
Incentive Program Data	I: Opt-in/opt-out consent	
Financing Data	V: Best practices for local governments	
Installer Data	II: Contract consent clauses	

Pathways to Auto-Population



By this point, the Journey Leader has completed the assessments needed to inform the decision-making process. Now this section lays out three implementation pathways for auto-population of solar data, with real-world insights provided by our journey navigation teams—look for the “Reflections from the Road” icons.

First, congratulations! Take a breath. Getting to this point in the Roadmap has required you to absorb a lot, including information and exercises related to:

- The primary partners and stakeholders and the likely role each will play.
- The solar marketplace, the implementation environment, and local business processes.
- The target data for auto-population.
- The challenges inherent with data access.



Now you have arrived at a “fork in the road,” ready to choose a preliminary pathway toward auto-population. Our journey navigation teams found that the push and pull of the assessment exercises propelled them toward particular pathways, based on their local situations. To help guide you, the Roadmap lays out three suggested pathways, each accompanied by a “Reflection from the Road” highlighting how the assessments helped the journey navigation teams prioritize their own path forward:

- Direct to MLS
- Publicly funded repository
- Solar industry collaborative repository

The common theme across all three pathways is the data repository. Regardless of pathway strategy, before data can be seamlessly auto-populated to a real estate application, they must be collected, cleaned, aggregated, and organized around RESO-compliant field groupings. This happens within the repository. Only the direct to MLS pathway leverages an existing solar repository. Under this approach, the repository will be the same functional database the primary data holder is currently using. The

other pathways require the buildout of a repository. In the graphics in this section, the repository (whether existing or new) is indicated in orange. Appendix B includes a basic blueprint that a Journey Leader or capable technical partners could follow to build a new repository.



Direct to MLS

The direct to MLS pathway is a public-private approach linking a data holder to a private entity that wishes to publish this information, such as an MLS. In most cases, MLSs outsource the process for importing public data to a tax aggregator, so this pathway assumes a tax aggregator is involved. A carefully established licensing agreement between the solar record agency and the tax aggregator on behalf of the MLS is essential to this approach.

How it works

1. The data holder and the assigned tax aggregator sign a licensing agreement to share data. The licensing agreement may contain a non-disclosure agreement, restrictions on further syndication of the data, and any fees or services required to share the data.
2. The tax aggregator has access to the solar data in the form of a database that may be accessed any time or regular updates via file-sharing or another method.
3. The MLS and tax aggregator follow standard protocol for listings in the MLS system. The core form is the listing agreement between seller and listing agent, which authorizes the listing agent to promote details of the property for sale (Figure 12).

FIGURE 12
Sample Listing Agreement

G R E A T E R B O S T O N R E A L E S T A T E B O A R D

AGREEMENT FOR EXCLUSIVE RIGHT TO SELL

Date: _____

THIS AGREEMENT concerns the following property:

Street Address: _____

Description: _____

Tax Id. _____ Book: _____ Page: _____ (if Registered) Cert. Num.: _____

County: _____ LISTING PRICE: \$ _____

In consideration of the mutual covenants and agreements herein contained, the undersigned Seller hereby gives to the undersigned Broker the sole and exclusive right to sell the said property for the price and on the terms and conditions herein set forth.

1. The Broker agrees to use reasonable efforts to procure a ready, willing, and able Buyer of the property in accordance with the price, terms, and conditions of this Agreement.
2. The Broker is granted the sole authority to: (Check if applicable)
 - Advertise the property;
 - Post "For Sale" signs on the property;
 - Offer compensation to buyer agents in the following amount: _____ and/or
Note: Regardless of how compensated, buyer agents represent the interest of buyers, not sellers.
 - Cooperate and compensate Subagents in the following amount: _____
Note: Subagents represent the interest of sellers, however, as agents of the seller, the seller may be held vicariously liable for the acts of the Subagents.
 Vicarious liability is the potential for a seller to be held liable for a misrepresentation or an act or omission of the subagent and in checking the box above and initialing below, the seller authorize the Broker to offer subagency to brokers and salespersons affiliated with other firms. Initials: _____
 - Cooperate and compensate non-agent Facilitators in the following amount: _____
3. The Seller agrees:
 - a. To refer all inquiries and offers for the purchase of said property to the Broker;
 - b. To cooperate with the Broker in every reasonable way;
 - c. To pay the Broker a fee for professional services of _____ if:
 1. A Buyer is procured ready, willing, and able to buy said property, or any part thereof, in accordance with the price, terms and conditions of this Agreement, or such other price, terms and conditions as shall be acceptable to the Seller, whether or not the transaction proceeds; or
 2. The said property, or any part thereof, is sold through the efforts of anyone including the Seller; or
 3. The said property, or any part thereof, is sold within _____ days after the term of this Agreement to

Source: Greater Boston Real Estate Board, printed with permission

- | | |
|--|--|
| <ol style="list-style-type: none"> 4. The tax aggregator performs address-matching between the solar data and the active listing feed. When the addresses match, the tax aggregator publishes the solar data to the corresponding MLS fields. 5. The tax aggregator provides the solar record data as part of the feed provided to the MLS. 6. The listing agent accepts, rejects, or adjusts the solar data matched to the property address as auto-populated by the MLS system. | <ol style="list-style-type: none"> 7. The solar data appear on the MLS listing per the licensing agreement in step one. Figure 13 provides an example of an existing (non-solar) direct to MLS approach between People's Gas, ComEd, and MRED, the MLS serving the Chicago area. 8. Solar data can be shared further on local broker websites, real estate portals, and so forth based on MLS data-syndication agreements. |
|--|--|

FIGURE 13

Sample of Existing Direct to MLS Approach


Welcome **Becky R Realtor** for **Team Becky**
Contact

My MLS
Search
Listings
Reports
Forms
Setup

Search Results - Attached Single

[List View](#)
[Refine Criteria](#)
Full - Agent
Show
Quick
Advanced

showing 1 of 1 listings



Detached Single

Status: **NEW** List Date: **06/26/2013** List Price: **\$399,900**
 Area: **8021** List Dt Rec: **06/26/2013** Orig List Price: **\$399,900**
 Sold Price:

Directions: **Diversey West to Rockwell, North to Property**

Sold by: Contract: Lst. Mkt. Time: **1**
 Closed: Financing: Points:

Off Market: Blt Before 78: **Yes** Contingency:
 Year Built: **1920** Curr. Leased: **No**

Dimensions: **37.5X125** Subdivision: Model:
 Ownership: **Fee Simple** Township: **North Chicago** County: **Cook**
 Corp Limits: **Chicago** # Fireplaces:

Coordinates: **N:2900** Rooms: **7** Bathrooms **1 / 1** Parking: **Garage**
 W: **2600** (full/half):
 Bedrooms: **4** Master Bath: **None** # Spaces: **Gar:2**
 Basement: **Full** Bsmnt. Bath: **No** Parking Incl. **Yes**
 In Price:

Utility Costs: Elec. - **\$770.60/yr,\$64.22/mo**; Gas - **\$1198.00/yr,\$99.83/mo**

Remarks: **CHARMING 4 BED+DEN, 1.1 BATH SINGLE FAMILY HOME ON LOT & A HALF IN DESIRABLE LOGAN SQAURE/AVONDALE LOCATION. REMODELED APPROX 10 YEARS AGO W/ NEWER HVAC, ELECTRIC, PLUMBING, H2O HEATER & ROOF. DIAG HDWD FLRS; LARGE EAT IN KITCHN W/ SS APPLS; HIGH CEILINGS; FULL BASEMENT; HUGE FENCED YARD W/ BLUE STONE PATIO; SECURITY SYS OVERSIZED 2 CAR GARAGE. CLOSE TO 90/94 & ALL LOGAN SQAURE/BUCKTOWN SHOPPING & RESTAURANTS!**

Source: MRED, LLC

FIGURE 14**Direct to MLS Pathway: Likely Flow of Auto-Populated Data****Tax aggregator imports data from the existing solar repository, then feeds to MLS****MLS imports directly from the existing solar repository**

Figure 14 provides a schematic of the likely flow of auto-populated data in the direct to MLS pathway.

When does this pathway work best? The direct to MLS approach is most appealing when one large MLS covers essentially the same footprint of homes as one solar record data holder—this enables one data-licensing agreement between the two entities to cover the entire area. For example, in Massachusetts, MLSPIN and its tax vendor, The Warren Group, cover more than 90% of homes in the state. The Massachusetts Clean Energy Center (MassCEC) comprehensively tracks solar records in the state—including all the target fields—and MassCEC and MLSPIN largely share the same coverage footprint.

When does this pathway not work well? The direct to MLS approach does not work well when geographies do not overlap. For example, nearly 20 MLSs operate across Colorado, with different tax aggregators, and solar records are stored by more than 60 counties and

hundreds of jurisdictions overall, each with different recording procedures. CEO seeks to auto-populate solar data to MLSs, but the myriad combinations of MLS areas and solar record areas make a direct to MLS approach unappealing as a statewide solution. If the direct to MLS pathway were chosen, it would need to be limited to large metro areas such as Denver and Boulder. The direct to MLS option can also be complicated if the solar data are not in a form that is easily imported into the aggregator, for example, if the data require extensive cleaning or quality control. Finally, this solution would not apply if there is an imminent threat of the data-collection program being retired, as when incentives are discontinued.

Key Success Factors: Success depends on an agreement between one established and committed real estate partner and one established and committed solar data holder around a mutual licensing agreement. Both partners should share the same overall coverage footprint.

Budget Considerations: The main upfront costs of the direct to MLS approach are the legal fees to establish the licensing agreement and the technology costs to establish the data share. A benefit of this approach is that it uses existing data repositories: the existing solar record repository, the MLS database, and potentially the tax aggregator database. There is no need or cost to build a new repository. The direct to MLS pathway

also has limited ongoing costs. As part of its business practice, the tax record aggregator is motivated to find and organize this sort of information on behalf of its MLS clients, although extensive cleaning and quality-control requirements could make this approach cost prohibitive. Costs associated with maintaining the system could be embedded in the vendor’s standard contracts and fees.



Reflections from the Road

Pathway Reflection: Direct to MLS Pathway

Balancing both the advantages and the barriers, which of the pathways is most appealing? The direct to MLS approach.

Why? There are three implementation partners that overlap and cover most of the state, including data source, aggregator and MLS. The MLS prefers this solution.

What challenges/opportunities will this approach satisfy? The data are currently private. There is no relationship

currently in place between the data holder and the tax aggregator. Associated costs for involved parties need to be explored and potentially recovered through fees.

What are the next three things that need to happen in your market to move forward on this pathway?

1. The three parties commit time to meet and explore next steps.
2. Data holder explores if there is any scenario where data might be shared.
3. Licensing agreement is explored between parties to accommodate parties for any associated costs.

Advantages for auto-population	Focus area	Barriers to auto-population
The full data set is available with one data holder.	Data	The solar data record holder and the aggregator have no relationship in place.
One MLS has very similar coverage footprint and is a willing partner in exploration of auto-population solutions.	Implementation	
The data record agrees there is value in having solar data at the point of sale.	Implementation	The data are currently private.
Inventory: More than 56,000 solar homes. ¹²	Market	

12 Source: Massachusetts Clean Energy Center, as of September 8, 2016.



Publicly Funded Repository

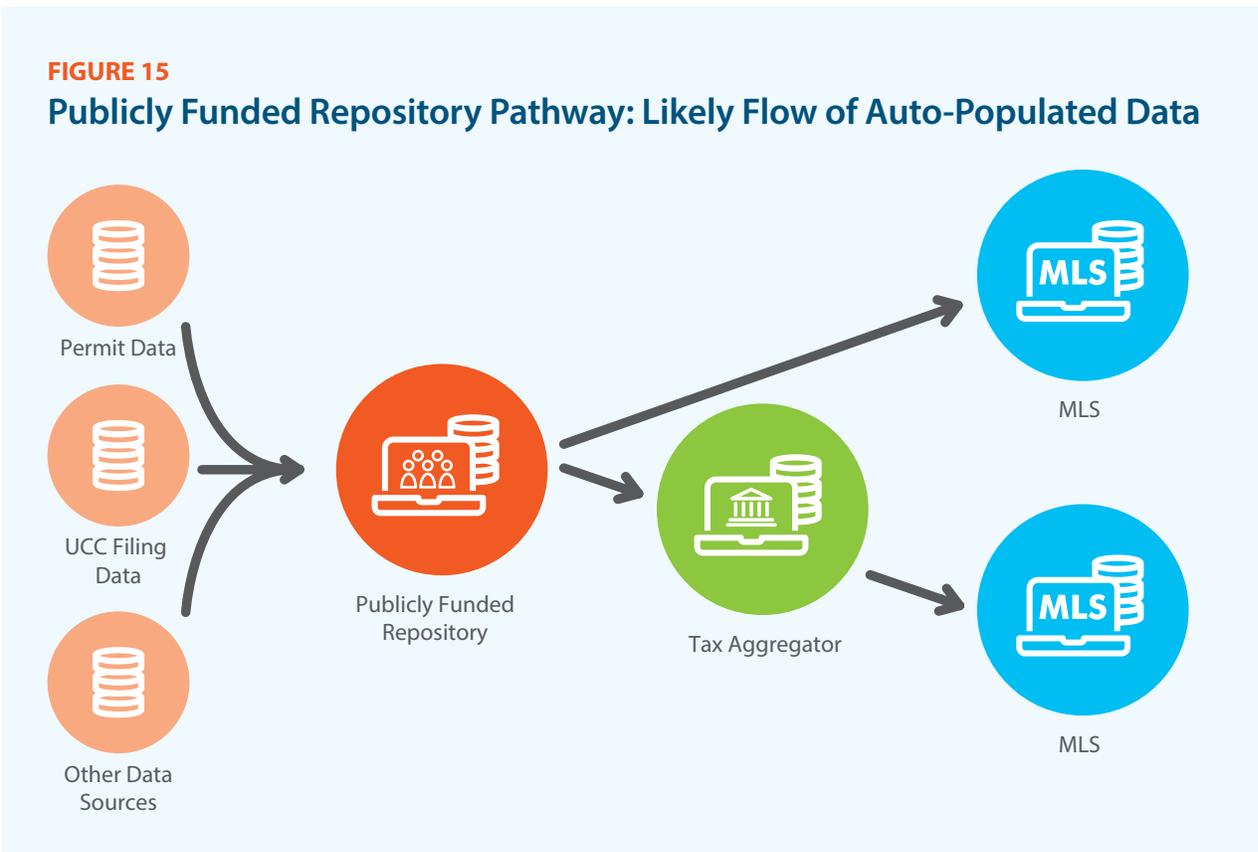
The publicly funded repository pathway may be appealing to Journey Leaders with a large or statewide vision for auto-population, including scenarios in which many jurisdictions cover both the real estate side and the solar data side. To aggregate solar records centrally in a streamlined way, the Journey Leader may seek public funds to establish an intermediary data repository that can pass records along to MLSs, tax aggregators, appraisers, and others.

How it works

This approach assumes the creation of a repository for aggregated solar data, which are then distributed to various outlets (Figure 15). The cross-stakeholder team led by the Journey Leader establishes the technology requirements for the repository as well as the standards that will allow ongoing updates and sharing protocols (see Appendix B). The team also needs to define the business model for sustaining the database, which may involve ongoing public funds, fees paid by members who are allowed to post, fees paid by feed subscribers, or other approaches. Options to share the solar data further on local broker websites, real estate portals, and so forth could be defined in MLS or other data-syndication agreements.

FIGURE 15

Publicly Funded Repository Pathway: Likely Flow of Auto-Populated Data



When does this pathway work best? The publicly funded repository pathway is appealing when there is a clear need to auto-populate solar data across a footprint with myriad real estate and/or solar record jurisdictions. This is a solution that builds one repository in the midst of many record holders and many MLSs. It's well suited to be the repository for permit and UCC filing data to which installer data might be added, if access becomes possible. It may work well when a solution is needed to streamline the data-sharing activities. It also works, in particular, when the MLSs and other real estate partners seek an “off-the-shelf” solution to enhance the services they offer to their subscribers. For MLSs and others that understand the need to share solar data based on established inventories—but do not wish to envision, design, or test solutions—the publicly funded repository pathway presents a work-around for engaging these key allies.

As an example, Northeast Energy Efficiency Partnerships (NEEP) launched a collaborative effort using a State Efficiency Program and other funds to create a publicly accessible database of energy ratings and other relevant energy information called HELIX. HELIX is envisioned

to be the data repository serving various stakeholders including real estate professionals, appraisers, lenders, and consumers across a multi-state region by providing reliable energy information during the real estate transaction.

When does this pathway not work well? The publicly funded repository approach does not work unless the target data are commonly collected on a permit and/or UCC filing. As more and more permit and filing data become accessible, especially to aggregators, this option will become more attractive.

Key Success Factors: The publicly funded repository pathway requires an effective Journey Leader, likely one who is associated with a recognized public agency. It also requires access to upfront funding or strong fundraising and team-building capabilities. A highly strategic focus is needed to establish a business model to sustain the repository once it is deployed.

Budget Considerations: Budget considerations include the high upfront costs to build the repository and the long-term funding planning that is required to sustain the repository.



Reflections from the Road

Pathway Reflection: Publicly Funded Repository Pathway

Advantages for auto-population	Focus area	Barriers to auto-population
The real estate market values solar.	Market	
There are 30,000 homes with solar (SEIA 2016b).	Market	
Permit data are public. The state can access funding and technical expertise to build the database.	Data	There is no standardized data-collection or sharing process. Utilities cannot share data.
There is an existing baseline data set to work from.	Data	Essential data points are often missing from permit data. There is a need to stitch together the data from several sources before it is useful.
Data sources and MLSs are willing to look at their systems to understand the barriers to change.	Implementation	A database and system must be developed.
	Market	A database and system must be developed.

Balancing both the advantages and the barriers, which of the pathways is most appealing? Publicly funded repository pathway.

Why? No existing database will allow a direct to MLS approach or enable aggregation, and the industry data are proprietary. Stakeholders understand the value of the vision, but no organization wanted to take on the role of building a central database. CEO, as a statewide entity, can bridge this gap. Thus the state can serve as a Journey Leader to address data and implementation barriers.

What challenges/opportunities will this approach satisfy? It will provide access to statewide data, but the challenge will be obtaining and maintaining a comprehensive and accurate data set. An API between systems will be a straightforward process, but we need to improve data quality before the system will be effective.

What challenges/opportunities will this approach not address? The approach will not involve obtaining data from utilities or solar installers, who have access to the most accurate data.

What are the next three things that need to happen in your market to move forward on this pathway?

1. Build the database.
2. Test the database uploading process and MLS integration with one county.
3. Reach out to a few targeted jurisdictions on collection and uploading of data and training on the database.



Solar Industry Collaborative Repository

Competitors Coca-Cola and Heinz are collaborating to invent low-cost renewable packaging that replaces plastics. Nike and competitors like Adidas and New Balance collaborate within the Sustainable Apparel Coalition, piloting an industry index to help manage risks, advance reputation management, and stay ahead of future regulations (Turiera and Cros 2013). Within the real estate industry, cooperation among competitors is why MLSs were first formed and continue to serve real estate brokerages as the go-to marketplace for home sales. Competitors in the solar installation industry are already working together on the Orange Button initiative (DOE 2016a), which is designed to lower overall costs

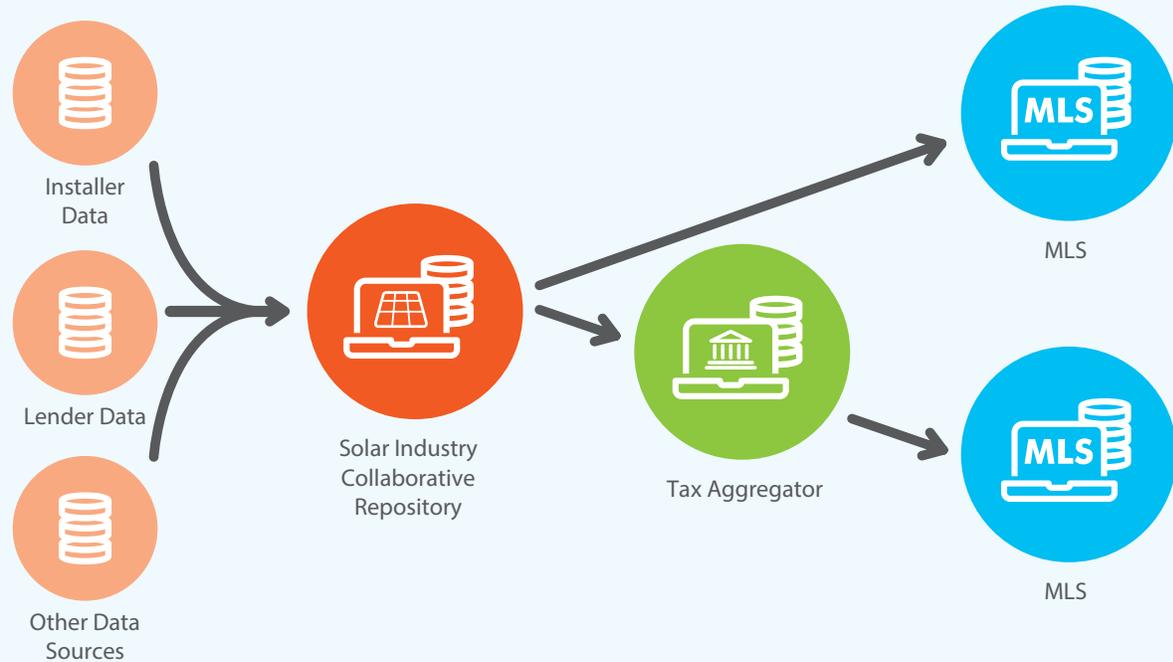
and standardize data on solar asset portfolios, and they previously worked together as part of the Solar Access to Public Capital (SAPC) effort (NREL 2016a). In the same spirit of collaboration, the industry could come together again with data-sharing standards that grow the overall market by ensuring that solar features are automatically and prominently featured in MLS listings. However, this approach would only include shared data from systems with which collaborating companies are involved.

How it works

As with the previous pathway, this pathway assumes the creation of a repository for aggregated solar data (Figure 16). Using the existing Orange Button initiative as a model, industry partners could designate standards and design a repository to host a subset of data on solar installations that could be applied to real estate listings and other channels (see Appendix B, page 70). Partners could determine a mechanism for gathering customer consent to share the data with the real estate industry, such as through an opt-out/opt-in strategy (see Appendix A, page 62). Permit and UCC filing data could, potentially, be added to the data set to supplement the installer data. Options to share the solar data further on local broker websites, real estate portals, and so forth could be defined in MLS or other data-syndication agreements.

When does this pathway work best? The solar industry collaborative repository pathway will only work when there is a mutual agreement to promote the industry from a number of solar companies that together capture a large portion of the market share. Solar project data maintained in the private sector is much higher quality and more comprehensive than public data. Based on the portion of companies that participate, this approach could essentially have a national coverage footprint. An industry collaborative approach at this scale is likely to be very appealing to real estate portals with national coverage such as Realtor.com and Zillow, to large national tax record aggregators such as CoreLogic and Black Knight, and to regional MLS providers that cover the largest population centers in the country (see Appendix C for more discussion of portals). As with the publicly funded repository pathway, the industry repository could streamline a solution to deliver these data to the real estate industry.

When does this pathway not work well? The industry collaborative repository pathway will not work unless

FIGURE 16**Solar Industry Collaborative Repository Pathway:
Likely Flow of Auto-Populated Data**

there is mutual agreement on the standards to contribute to the repository, how consent will be obtained from customers, the methods for syndicating information to the real estate industry, and the model for funding and managing the system. Because of the coordination and investment required, competitors could create a repository at a local level, but the impact would be very limited compared to the cost. Further, in markets with a large portion of independent installation companies—especially those that install homeowner-owned systems with no performance guarantee—centralized high-quality data collection likely will be limited.

Key Success Factors: The industry collaborative repository pathway requires a Journey Leader who is perceived as fair and can serve as a neutral party to participating organizations and a set of installers that represent a large percentage of the installations in the footprint

Budget Considerations: Budget considerations include a high upfront cost to build the repository. A fee structure would also need to be established to sustain the repository.



Reflections from the Road

Pathway Reflection: Solar Industry Collaborative Repository Pathway

Advantages for auto-population	Focus area	Barriers to auto-population
There are more than 79,000 solar homes. ¹³	Market	
Solar installers and lenders hold high-quality data for a subset of the market.	Market	Installer and lender data are proprietary.
The market has a large, diverse, and engaged installer base.		
All interconnected system data are published by the utility via the Public Utilities Commission.	Regulatory	Addresses are redacted under current regulation. Changing this rule would require a significant legislative or regulatory change.
Local permit data are public and freely available directly from jurisdictions. Permit data aggregators also offer access to basic permit information for a subscription fee.	Data	There are many jurisdictions each holding their own data sets in different formats. Permit data tends to only include year of installation and none of the other desired data points.
The MLS is open to the possibility of adding additional solar fields.	Implementation	Adding fields would require approval from three Realtor boards.

Balancing both the advantages and the barriers, which of the pathways is most appealing? Solar industry collaborative repository pathway.

Why? The solar market is maturing, and working on a market solution could lead us to implementation sooner. Pursuing an industry repository could be high risk, but high reward. The solar companies have the best quality data, but obtaining it would involve building consensus among private companies. San Diego could be a good pilot location for a national effort, given the maturity of the local solar market. Pursuing use of the interconnection data would also be very challenging given the legislation, regulation, or opt-in overhaul that would be required. A private aggregator using local permit data could be relatively simple, given that aggregators are already collecting solar permit data, and this could be used to supplement the data set where there are gaps, but with only year of installation data.

What challenges/opportunities will this approach satisfy? It presents an opportunity to populate all of

the desired data fields, for a portion of the installations, but it depends on the will of decision-makers at private companies.

What challenges/opportunities will this approach not address? Some companies may not wish to provide data, while others might be too small and too numerous to contact, leaving gaps in the coverage.

What are the next three things that need to happen in your market to move forward on this pathway?

1. Demonstrate the industry value proposition of sharing data. Approach record holders as a collective group through a convening association such as SEIA or SEFA.
2. Work with decision-makers in legal departments to work through concerns about data sharing and customer privacy.
3. Work with the three Realtor associations that own the local MLS provider to secure approval to add solar fields.

¹³ Inventory number as of June 2016 (Go Solar California 2016).

Journey Leader Exercise: Your Local Pathway Reflection



A. Is there a journey underway? Or is your area exploring?

B. What are the two most significant advantages and barriers in your market environment?

Advantages	Barriers
1.	1.
2.	2.

C. What are the two most significant advantages and barriers in the implementation environment?

Advantages	Barriers
1.	1.
2.	2.

D. What are the two most significant advantages and barriers in the data environment?

Advantages	Barriers
1.	1.
2.	2.

E. What are the two most significant advantages and barriers in the regulatory environment?

Advantages	Barriers
1.	1.
2.	2.

F. Overall, rank all the advantages from the most helpful (#1) to the least helpful (#8). Enter in order in the table below.

Advantages
1.
2.
3.
4.
5.
6.
7.
8.

G. Overall, rank all the barriers from the most challenging (#1) to the least challenging (#8). Enter in order in the table below.

Barriers
1.
2.
3.
4.
5.
6.
7.
8.

H. There are three suggested pathways to auto-population implementation. Based on your actual or expected advantages balanced against the barriers, which of the pathways seems most appealing?

- Direct to MLS
- Publicly funded repository
- Solar industry collaborative repository

1. Why?
2. What challenges/opportunities will this approach satisfy?
3. What challenges/opportunities will this approach not address?
4. How did you resolve the balance between what could be satisfied and what cannot?
5. What are the next three key things that would have to happen in your market to start moving forward on this pathway?

Implementation Preview



This section provides a very brief overview of considerations related to implementation. These strategies are not exhaustive or intended to constitute a specific implementation guide, but they are important to remember as the journey turns toward implementation.

Evolving Partners

Once implementation comes into focus, the key travel partners may evolve. Bridge partners, such as real estate agents and appraisers, Realtor associations, and MLSs and their software vendors might take on a more active role. It is important to keep these stakeholders engaged at key points throughout the journey to encourage participation during implementation, which will consist of several significant phases:

- Designing the integration process and flow
- Building out the supporting technology on the repository side and the MLS (or vendor) side
- Testing and piloting
- Final implementation

Planning

The scope of the implementation plans must be supported with careful funding strategies and work-planning efforts. The Journey Leader should understand what tasks key partners might provide resources for versus those tasks that may require additional funding streams. For example, under the solar industry collaborative repository pathway, an industry association might establish the business model to support the technology requirements, and participating MLSs might cover their costs to import these data, while additional fundraising might be needed to cover a training and outreach campaign in participating markets.

Communication, Training, and Outreach

All technical and process-related plans should be supported with communication, training, and outreach plans for MLS users, real estate agents, and appraisers. A consumer outreach campaign could strengthen end-user understanding and support of the overall implementation.

Maintenance

The last initial consideration for implementation includes planning for the ongoing success of the program. This includes thinking through a maintenance and operation plan and a continuous improvement plan. The Journey Leader could also begin to think through the shape of a research plan to evaluate the impact on solar home valuation after auto-population has been implemented for several years.

Conclusion



Auto-population of data into an MLS enhances the capabilities of the MLS and provides valuable information to home buyers, sellers, real estate agents, appraisers, and others involved in real estate transactions. Successful new auto-population of energy attributes cases are emerging. For example, in Chicago, an initiative to allow direct disclosure of residential energy costs via the MLS (see Figure 13, page 49) shows that homes that disclose this information have a higher close rate and spend less time on the market.

The auto-population of solar data will improve the overall process for promoting, assessing the value of, and closing on a solar home. Auto-population will vastly increase the quality and quantity of data available during the real estate transaction. This may contribute to the establishment of a consensus that a “solar premium” exists in the marketplace, which will help grow demand for these special homes and incentivize investment in renewable energy.



The challenges to solar data auto-population, however, are as clear as the benefits. Data access is the single biggest obstacle. Numerous sources of data exist, but no single data holder provides *all* the access to *all* the data. Further, the best solar data available are currently private. There is also a regulatory balance to be struck among states and local governments with regard to protecting consumer privacy versus enhancing transparency and access in support of an informed and effective marketplace. Even if the data-access conundrum is solved, Journey Leaders and other partners will need funding and support to design, build, implement, and maintain auto-population technology.



Yet we see positive momentum. The growing consumer demand for solar homes and the increase of solar inventories to more than 1.1 million U.S. homes has enhanced the business case for MLSs to invest in making solar fields available. Recognizing this, RESO this year updated its data dictionary standard to include a core set of fields for solar systems. These standards set the stage for solar advocates to evolve alongside real estate advocates to make information about solar homes more accessible.

This Roadmap is intended to guide readers through a practical assessment for identifying the best local strategy for auto-population. The three recommended pathways are informed by real-life teams working across the country on early implementation strategies. These recommended pathways are:

- **Direct to MLS:** This pathway is a public-private approach toward auto-population that links a data holder to a private entity that wishes to publish this information, such as an MLS.
- **Publicly Funded Repository:** This pathway focuses on the centralized aggregation of solar records in a repository that can deliver records to the MLS and other entities.

- **Solar Industry Collaborative Repository:** This pathway brings together industry partners to design a repository that hosts data on solar installations that could be applied to real estate listings and other channels.

The publication of the Roadmap itself is a step toward auto-population. Over the last year, the Roadmap brought together teams of experts for conversations that accelerated the group from localized on-the-ground activities to a collective vision of auto-population. Each of the recommended implementation pathways is already advancing. Tax aggregators are beginning to talk to state solar agencies, the HELIX project (a collaborative effort to create a publicly accessible database of residential energy information) is underway, and initiatives like the Orange Button suggest that a solar industry repository is feasible.

Journey Leaders should not be discouraged by the complex scope of auto-population. Take the first step, and use the Roadmap as a foundation for your own early conversations. The Roadmap can guide you through the key questions to ask now—and help illuminate the best pathway forward later.

Appendix A: Accelerating Access to Solar Data – Detailed Descriptions and Examples



This appendix elaborates on the barrier busters introduced in Guidepost Three to overcome data-access challenges.

Barrier Buster I: Opt-In/Opt-Out Consent

This strategy seeks to obtain consent to access the data of customers who have already installed solar on their homes. The installations occurred under existing legislation, regulation, and privacy policies, which do not generally provide public access to the data. Getting the data requires getting ex post facto customer consent. There are two main types of consent mechanisms: opt-in and opt-out.

Opt-in consent requires an affirmative choice from the customer to share their data. The customer gives the data holder (such as the utility, state agency, or other third party) the authority to share the data with another third party, affirmatively signaling their permission and agreement with the consent clause. Customers who do not respond to the opt-in consent request may have to

be re-contacted using a different consent mechanism, e.g., a letter included with a monthly statement.

Opt-out consent creates a default setting in which all customers agree to share their data unless they choose not to participate in the data-sharing program. If the customer does not object, then their information—which is held by a utility, state agency, or third party—will be shared according to the terms written in the consent clause.

Consent will be given to the entity holding the data. Therefore, it is best that they **seek consent from their customers on behalf of the MLS**. Obtaining customer consent is a multi-step process for the Journey Leader addressing the data-access, data-privacy, data-management, and liability concerns of each party (Figure 17). An opt-in approach will likely result in lower participation rates, but data-holding entities may prefer the higher level of transparency associated with this approach.

FIGURE 17
Steps to Initiating Opt-In/Opt-Out Consent



Best Practices for Opt-In/Opt-Out Consent

Regardless of the communication mechanism, a number of particulars will need to be included in the correspondence:

- Clearly identify the entities sharing and receiving the data.
- Include liability release for the data-sharing entity. Release should cover several actions:
 - ▶ Transfer of data to the third party
 - ▶ Unauthorized use of data by the third party
 - ▶ Data management by the third party
- Disclose why the data are being collected. For example:
 - ▶ To auto-populate MLS listings
 - ▶ To establish a basis for valuation of the customer’s installed solar

- Indicate that the information will not be used for direct marketing, only for the stated reasons.
- Explain how the data will be collected and turned over.
- Explain any data-protection protocols that will be used to manage access to the data and protect the data from unauthorized use.
- Under the opt-in mechanism, a customer must provide affirmative consent before their data can be shared. Therefore, contacting customers multiple times will likely be necessary to achieve a good response rate. Alternative contact methods for multiple contact attempts should be discussed with the data-sharing entity.

Figure 18 shows a sample opt-out postcard for sending to customers.

FIGURE 18
Sample Opt-Out Postcard

Dear Customer of Record,

Your solar array is an important investment and we want to help you recoup the proper value for the system if you sell your home. [Entity] will soon begin a data sharing program with [Authorized Third Party] to auto-populate real estate multiple listing services with information on solar systems in our service area. The program will share the following static system characteristics: Address, Array Size, Date of Installation, Ownership Type, and Estimated Annual Production. Additionally, the program will share the variable production data statistic of Actual Annual Production. More information on the program is available at [URL/Phone Number].

Information will only be shared with the [Authorized Third Party] and used for the purposes listed above.

If you do not wish to participate in this program, please complete and return the following form.

I have reviewed the materials on the data sharing program, and I choose to opt-out of the program.

Name (Please Print)

Signature _____ Date _____

Place Stamp Here

Data Holder
Return Address
Chicago, IL 60607

Barrier Buster II: Contract Consent Clauses

This strategy is designed to collect data from *future* system installations. These could either be new consent clauses or the amendment of existing confidentiality and third-party data-access clauses to gain the customer's consent to access their data.

Clauses could include opt-in or opt-out language. As such they should adhere to the best practices noted for Barrier Buster I (page 62). Most importantly, they must provide an explicit description of what the data will be used for and how their use will be restricted to protect customer privacy. Clauses should clarify that the goal is to share data with the MLS or additional data syndicators like real estate portals.

The installation process offers multiple potential data-collection points as the customer interacts with their utility and other third parties. Potential points of contact include:

- System warranties
- Renewable credit registries
- State and local incentive programs
- Third-party lease agreements
- PPAs
- Financing agreements

Each point of contact represents an opportunity to insert a clause that will facilitate the collection and sharing of static and actual production data. Each point of contact should be assessed for its ability to deliver accurate and complete data sets. System installation contracts and utility interconnection applications have the greatest potential for contract consent clauses, because they collect full sets of accurate data. Sample clauses are provided for these two examples in Table 2, and they could be altered for specific use by legal counsel.

Barrier Buster III: Draft Legislation

This strategy creates new legislation or amends existing legislation to allow the collection, disclosure, and access to historical and/or future customer data.

Drafting specific and precise legislation to enable the collection and sharing of solar data combats the legislative trend toward increased broad data-privacy protection (discussed on page 39). Draft legislation must accommodate the twin goals of enhancing data privacy for information that can reveal behavioral patterns and increasing data access on renewable energy installations. A balance must be struck within the current and future legislative trends, because data privacy and data access need to be viewed as complementary rather than conflicting.

Drafting new legislation or amending existing legislation comes with a serious caveat. The process is lengthy and costly. Multiple parties must be consulted, multiple iterations must be produced, and there may be opposition to the proposed changes by parties with differing viewpoints. Nevertheless, drafting new legislation or amending existing legislation is still a viable option in some scenarios and should, at least, be considered.

Potential areas for legislation include:

1. Privacy laws: Privacy laws refer to any federal, state, or local legislation that protects a person's right to be left alone and reasonable expectation of privacy (Warren and Brandeis 1890). Privacy laws govern the collection, storage, use, and disclosure of the personal sensitive information that the person provides in the course of everyday transactions. Privacy laws are the logical starting point to be considered by the Journey Leaders, because they often contain provisions on what data are considered public or private, the process of access, and the disclosure of data.¹⁴

¹⁴ See, for example, the Electronic Communications Privacy Act of 1986 - 18 U.S. Code sections 2510-2522, 2701-2711, 3121, and 1367; Federal Privacy Act of 1974 - 5 U.S. Code §552a; Energy Independence and Security Act of 2007; Fair Information Practice Principles adopted by the Department of Homeland Security; Stored Communications Act; Data Guard Voluntary Code of Conduct; Consumer Privacy Bill of Rights; Federal Trade Commission Codes of Conduct; and Fair Information Practice Principles.

TABLE 2
Sample Contract Consent Clauses

Solar Installation Contract Data Sharing Draft Clause:	Interconnection Contract Data Sharing Draft Clause:
<p>The solar system installation contract refers to the agreement between a contractor/third-party installer and a customer for the purposes of installing a solar array.</p>	<p>The interconnection contract refers to the contract between the utility and the customer, for the purpose of allowing the PV system to be connected to the electric grid.</p>
<p>“The customer hereby consents to allow the collection and storage of the following specific static and actual production data by the installation contractor in order to be disclosed through accepted and secure methods of data transportation, for the specific purpose of publishing to the local Multiple Listing Service (MLS) with authorized real estate data syndication partners and promoting the solar system investment when customer sells their home.</p>	<p>“The customer hereby consents to allow the collection and storage of the following specific static and actual production data by the utility in order to be disclosed through accepted and secure methods of data transportation with authorized real estate data syndication partners, for the specific purpose of publishing to the local Multiple Listing Service (MLS) and promoting the solar system investment when customer sells their home.</p>
<p>The data fields are: (1) Home Address (Street Address, Municipality, State, Zip Code) (2) Installation Date (3) System Size (kW) (4) Ownership Type (5) Estimated Annual Production Capacity (kWh) (6) Actual Annual Production (kWh)</p> <p>The authorized real estate data syndication partners do not make and do not have any claims of ownership or of proprietary rights in the data fields disclosed to them, and will use and protect the data in accordance with existing and emerging best practices, national standards, and state and federal laws, privacy rules, and statutes.</p>	
<p>When the authorized real estate data syndication partners undergo a change in ownership, the installation contractor is under no duty to notify the customer of this change in ownership, and the new owner is authorized to receive the static and actual production data which will be used only for the specific purpose as agreed herein. However, the new owner receiving the data fields must notify the customer of the change in ownership.</p>	<p>When the authorized real estate data syndication partners undergo a change in ownership, the utility is under no duty to notify the customer of this change in ownership, and the new owner is authorized to receive the static and actual production data which will be used only for the specific purpose as agreed herein. However, the new owner receiving the data fields must notify the customer of the change in ownership.</p>
<p>The customer acknowledges that the data fields, as listed above, will be shared with authorized real estate data syndication partners. The customer does not authorize the data to be sold to or used for direct marketing purposes.”</p>	<p>The customer acknowledges that the data fields, as listed above, will be shared with authorized real estate data syndication partners. Absent express customer consent, any personally identifiable information provided by a customer to a utility or to the Public Utilities Commission itself during the interconnection process is subject to a reasonable expectation by the customer that the information will be kept private. The customer does not authorize the data to be sold to or used for direct marketing purposes.”</p>

2. **Public records laws:** State public records laws establish the rules for accessing government agency data. Each state public records law will have a list of exemptions for removing data from the public realm. As discussed in the public records request section that follows, the exemptions can block access to rooftop solar data. Amending the exemptions or clarifying the extent of the exemption could increase data access.
 - ▶ Massachusetts (General Court 2010)
 - ▶ Oregon (Legislative Counsel's Office 2014)
 - ▶ Washington (Washington State Legislature 2016)^a
3. **State utility regulation:** The laws and regulations governing a state public utility commission are a natural starting point for directing utility action. IOUs are regulated by state public utility commissions, which in turn operate under authority granted by the state legislature. Public utility commissions can issue rules and regulations on a wide range of areas, including protecting the privacy rights of customers. A public utility commission can set how the utility will manage access to a customer's energy use and energy production data. Developing specific rules for the treatment of solar system data could improve data access while continuing to protect sensitive customer data such as household electricity consumption. Another area of potential change could be how utilities determine what is a primary purpose and a secondary purpose (see page 39). This distinction affects when customer consent is required to release data to a third party.
4. **State agency function:** In many states, state government agencies oversee solar incentive programs, renewable energy credit registries, property and sales tax exemptions, and NEM applications. Amending an agency's authorizing legislation or operating regulations could improve data collection and sharing practices for authorized third parties.



For More Information

There are a number of online resources on drafting legislation at the federal and state level.

- The federal government publishes the “House Office of the Legislative Counsel Guide to Legislative Drafting” (HOLC 2016).
- Many states offer specific guidance on drafting legislation. Some examples include:
 - ▶ California (California State Senate 2016)
 - ▶ Delaware (Legislative Council 2013)

Barrier Buster IV: Public Records Request

Public records contain historical data on rooftop installations, and they will serve as the repository for data generated from future installations, but in most jurisdictions, these data are considered private. A public records request is a written or oral request made by the public to any state agency for the release, access, inspection, and copying of public records. Every record that is made or received by a government entity or employee is considered to be a public record, unless it is subject to a statutory exemption from disclosure to the public.

The public records request process must be well understood by the applicant, and, to obtain access to the required information, the request must be specific in terms of time frame and record type. A public records request should only follow a failed attempt to engage with the data holder informally. Understanding why the data holder will not release the data is a key element in shaping a successful request.

The records custodian must respond to the request in writing, usually in 2 to 20 days (Ballotpedia 2016). If the records custodian fails to respond or denies the request, a written appeal is possible, but with strict deadlines. If a state agency denies the request, it must provide written explanation citing a specific exemption. If the request is granted, a fee may be required to cover the agency's cost in preparing the request. The fee amount should be provided at the same time the request is granted, giving the requestor the opportunity to decline.

When making the request, there are steps to follow (Ballotpedia 2016):

1. Target the appropriate person (“record custodian”) in charge of this process, often found on the agency website.¹⁵

¹⁵ “Submitting an open records request to a state, county, or local government is not difficult. However, a complete, well-written letter or email submitted to the right agency will increase your chances of getting a satisfactory response and avoiding delays or the need for further correspondence” (NFOIC 2016).

2. Make sure the request contains reference to specific data fields, because a request can be rejected for vagueness. Be specific in terms of time frame and record type.
3. Submit the request in writing, even when it is not required, to have documentary evidence of the submitted request. Figure 19 provides a letter template.
4. Check the state public records law for a list of exemptions and the costs for obtaining data.
5. Send your request by regular first-class mail, certified mail, fax, or email, or deliver it in person.

FIGURE 19 Example of a Public Records Request

[Your Name]
[Street Address]
[City, State, ZIP Code]

[Date]

[Name of Custodian of Records]
[Title]
[State Agency]
[Street Address]
[City, State, ZIP Code]

Dear [Custodian of Records]:

“Under the [insert state] Public Records Act [insert citation to legislation], I am requesting an opportunity to inspect or obtain copies of public records that include information on all interconnection applications/all solar incentive payments/all solar permits/etc. for residential solar installations connected after [insert date]. I seek any records that include the following system characteristics, if available: the date or year the system began operation; the size (in DC watts) of the system; if the system is owned by the homeowner or a third party (as would be the case for a leased system); the annual estimated system output in kWh; and the annual actual system output (in kWh). If there are any fees for searching or copying these records, please inform me if the cost will exceed [fill in the \$ sum].

The [insert state] Public Records Act requires a response within [insert number of days] business days. If access to the records I am requesting will take longer, please contact me with information about when I might expect copies or the ability to inspect the requested records.

If you deny any or this entire request, please cite each specific exemption used to justify the refusal to release the information and notify me of the appeal procedures available to me under the law.

Thank you for considering my request.

Sincerely,

[Your Name]
[Your Phone Number]



For More Information

There are a number of online resources on submitting public records requests:

- Ballotpedia (2016) contains a general description of the process of submitting a request.
- The National Freedom of Information Coalition offers state-specific sample Freedom of Information Act public records request letters (NFOIC 2016).
- FOIAAdvocates (2016) provides links to each of the state public records laws.

Barrier Buster V: Best Practices for Local Governments

Local governments may be able to influence how permitting and PACE programs are designed and administered in support of auto-population processes. An analysis of solar permitting trends is provided below.

Permit fields: When updating the process for building and electrical permits, or when introducing a process specifically for solar permits, local permitting agencies could encourage a consistent field and units of measurement to record the size (capacity) of the solar system. The size should be recorded in kW DC to be consistent with the standard RESO field specification, and, ideally, the ownership type as well (see Appendix D, page 75).

Design of new PACE programs: Sponsoring entities for new PACE programs could explore ways to make details about solar systems financed through the program available to populate the local MLS. Such details could be limited to overlap with the key fields for solar systems included in the standard RESO field specification (see Appendix D, page 75).



Automating Access to Permit or UCC Filing Data?

State administrative and other processes may have implications for auto-population, especially processes for public records such as permits and UCC filings, but also interconnection processes. Jurisdictions

will vary in their investment in technology upgrades. Some jurisdictions grant electronic access to their building and electrical permits, while others maintain paper records that can be accessed by the public. Some jurisdictions, such as San Diego (CivicData 2016a) and Boulder (CivicData 2016b), may already be adopting Building Land & Development Specification (BLDS), a standard for sharing open data on building and construction permits issued by municipal governments (BLDS 2016). In addition, software options may exist to automate and streamline the permitting process and to improve the raw data available for potential auto-population. San Diego County is using Accela software to streamline and automate the permit process for solar systems (Accela 2016). Similarly, UCC filings could be automated and streamlined to improve what data could be made readily available.

Barrier Buster VI: Using Data Mashups to Increase the Volume of Solar Data Available

A more robust set of solar data for auto-population might be created by merging different partial data sets. Permits, UCC applications, and anonymized incentive and interconnection data are examples of partial data sets, which might mean only a portion of the target data fields is available and/or addresses are redacted. Using analytics, data innovators might be able to match different data sets with probabilistic techniques to create a more comprehensive property record. Examples might include matching address and year of installation on a permit with ZIP code, matching year of installation and solar system size on a UCC filing, and using probability calculations to determine the range of matching accuracy. Such an effort would likely include an innovation phase to determine the precision in matching records and then a use-case phase to evaluate if data quality allows consideration of auto-population.

Trends in Solar Permit and UCC Application Data

To better understand how permit and UCC filing data might fit together, the Vermont Law School's Institute for Energy and the Environment reviewed general commonalities between solar building and electrical permit data, UCC application data, and RESO compliant fields for solar. Key findings from the review are presented below.

Data *consistently published* on permits:

- The address where the solar system is installed
- The year the system was installed

Data *inconsistently published* on permits:

- The size of the solar system. If these data are published, they may be in a remarks field and not in a standard format. If published, the unit of measure also varies widely. For example, some permits may record number of panels, while others may record estimated power (kWh).
- The type of ownership for the solar system (UCC filings only)

Data *not published* on permits:

- The actual or estimated annual system output

Some jurisdictions have a dedicated solar permitting process that exists outside of the regular building and electrical permitting processes. Such dedicated permitting processes capture more detailed information. Beyond permits, publicly available UCC filings available through a state registry can indicate if a system is leased. Accessing the UCC filing registry is accomplished using name and address data gleaned from a building and electrical permits registry.



New Partners for Data Mashup?

Among the data aggregators described in this paper, permit aggregators complete the laborious task of pulling records from township offices, county clerks, and elsewhere, and make them usable for customers in real estate and other industries. It could, perhaps, be a minimal stretch for these companies to add solar data permit collection to existing processes, consider adding UCC filings to the collection process, and even consider adding address redacted incentive or interconnection data, if probabilistic matching is deemed feasible. Therefore, a possible business opportunity exists for data aggregators, and permit aggregators specifically, to provide solar data services to MLSs, tax aggregators, portals, or solar repositories.

In other words, there might be many different combinations of partners working toward the same goal of getting a RESO-compliant data set of solar data prepared to share with the MLS.

Appendix B: Blueprint for a Solar Data Repository



The Roadmap presents three suggested pathways toward auto-population: direct to MLS, publicly funded repository, and solar industry collaborative repository (page 54). The common theme across all pathways is the RESO-compliant data repository. The requirements for building and supporting repository business models are an evolving topic. Partners of the DOE Home Energy Information Accelerator (DOE 2016c) are exploring these topics today, and Journey Leaders can track this initiative over the next several years. In the meantime, some high-level technical considerations can provide guidance now. This appendix includes a basic blueprint that a Journey Leader or capable technical partners could follow to build a new repository or augment an existing one.

Business model

Building a solar data repository follows the standard technology approach of plan, design, build, test, and implement. A repository also requires a sustainable “owner” and a funding structure to operate, maintain, and improve it. A business model that is carefully planned upfront will improve the long-term viability of a repository. Several business model options are worth considering:

- **Membership fee model:** Members pay a fee to participate, and only members are allowed to submit data to the repository. This model might work best for members who wish to maintain close control of the repository and who see the repository as a tactic to improve solar awareness or create growth opportunities for the overall industry.
- **Subscriber fee model:** Real estate partners and others pay a fee for solar data feeds. This might include an MLS or a tax aggregator that might pass subscription fees along to their MLS customers or real estate portals. Data-swap arrangements might be negotiated instead of fees; for example, an MLS receives a data feed at no cost in exchange for providing the industry group with closed sales

data to advance research efforts. This model might work best when research on the potential user base (real estate agents and appraisers) indicates they are willing to pay a subscription fee to have access to this data. In this case, the value proposition should be clearly articulated alongside sales and marketing plans and a funding stream.

- **Grants and fundraising model:** Foundations and other funding sources sustain the repository. Membership or subscription fees might supplement any grants. This model is not likely to work over an extended time frame. However, it might work best when the repository includes other relevant property information outside of solar such as green building certification data and efficiency scores.

Consent Process

All repositories need incoming data, and some might require consent. The consent process should clearly define the use of public data or explain how consumers will opt-in or opt-out of the data flow. The consent approach for future installations might be different than for historical records. Journey Leaders should consult legal counsel when considering a consent process.

Data Strategy

Journey Leaders will need to consider several data elements and processes:

- **Strategy on standards and open source code:** Energy efficiency advocates pursuing similar efforts towards auto-population are evaluating the benefits from leveraging data standards and open source codes that create a low-cost technology base. Initiatives to evaluate include Home Performance XML (HPXML), a data-transfer standard (Home Performance Coalition 2016); Building Energy Data Exchange Specification (BEDES), a data dictionary standard (DOE 2016d); and SEED Platform (DOE 2016b), an open-source software application for managing and sharing energy data.
- **Data type:** The overlapping set of fields between the solar installation and the real estate transaction is relatively small. Therefore, each individual record in a solar repository will be fairly thin. At a minimum, the repository should include static data (see page 30). Actual production data are the ultimate goal, and they should be included whenever possible.
- **Data-security model:** Once data enters the repository, it must be protected so that only authorized users have access. Journey Leaders should consult legal counsel before finalizing a data-security model.
- **Protecting the data:** The Journey Leader is likely to find that data holders, aggregators, and MLSs share one key motivation: protection of data. Privacy requirements are paramount and will vary by location.
- **API:** The function of the repository is the intake, preparation, and outflow of data. Generally, the real estate industry is moving toward APIs (see text box)

that allow nimble and effective interconnections rather than custom coding options. The repository end product must be compatible with the RESO Web API standard so it can be smoothly imported by real estate partners.



Real Estate Mandate for APIs

An API is a set of routines, protocols, and tools for building software applications, which specifies how software components should interact. Effective June 30, 2016, all Realtor-owned or associated MLSs must adopt RESO's Web API standard to encourage industry interconnectedness. RESO provides certification services to help Realtor-owned or associated MLSs ensure correct adoption and demonstrate compliance with the mandated MLS policy (RESO 2016c).

- **Data-validation process:** Solar data will be auto-populated on the MLS or real estate portal when the repository export file matches an actual real estate listing. Today, data validation most often uses property address fields. Geocoding (translating property address information into map coordinates) also helps ensure accurate record matching. RESO and other groups are looking into standards that could create unique property identification numbers that could further streamline record matching and validation. Home Energy Information Accelerator partners are also currently exploring data-validation efforts.

To date, no known vendors exist with capabilities to build a repository that would aggregate and clean solar data and then share it with real estate applications. However, some potential players are emerging through the Home Energy

Information Accelerator, including public databases, software vendors, and service providers from the energy efficiency and real estate industries. Table 3 provides a suggested checklist for building a repository.

TABLE 3
Suggested Checklist for a Repository Build

High-Level Technical Specifications	Solar Industry Collaborative Repository	Publicly Funded Repository
Potential business models	<ul style="list-style-type: none"> • Membership fee model • Subscriber fee model 	<ul style="list-style-type: none"> • Membership fee model • Subscriber fee model • Grants and fundraising model
Potential consent process	<ul style="list-style-type: none"> • Industry group provides best practices on consumer consent • Industry group provides best practices on consumer participation campaigns • Participating members define their own consent process directly with eligible consumers 	<ul style="list-style-type: none"> • Journey Leader or an alliance provides best practices on consumer consent • Journey Leader or an alliance provides best practices on consumer participation campaigns • Participating non-profits, agencies, or utilities define their own consent process directly with eligible consumers
Core repository specifications	<ul style="list-style-type: none"> • Standard definitions/authorizations for input users (who can write, edit, delete) • Standard definitions/authorizations for access users (who can read or download) • Licensing agreements for all input users and access users • RESO-compliant fields and output 	
Data flow	<ul style="list-style-type: none"> • Industry group sets import standards for RESO compliant fields 	<ul style="list-style-type: none"> • Journey Leader or an alliance sets import standards for RESO compliant fields
Security model	Evolving area. Consult Data Guard as a starting point.	
API	<ul style="list-style-type: none"> • Industry group creates a standard API to export files • Export file is compatible with RESO API 	<ul style="list-style-type: none"> • Journey Leader or an alliance creates a standard API to export files • Export file is compatible with RESO API
Data-validation process	Evolving area. Track Home Energy Information Accelerator for possible progress. Consult RESO as a starting point.	
Pilot testing	Suggested targets: <ul style="list-style-type: none"> • 1 large, national tax aggregator, plus 1-2 of their MLS clients • 1 small, national tax aggregator, plus 1-2 of their MLS clients • 1 real estate portal 	Suggested targets: <ul style="list-style-type: none"> • 1 tax aggregator working locally, plus 1-2 of their MLS clients

Appendix C: What about Real Estate Portals?



Real estate portals are a key way to reach consumers, but what is their role in an auto-population strategy? The following list of frequently asked questions may shed some light on this topic.

What are the options to share solar data with a real estate portal?

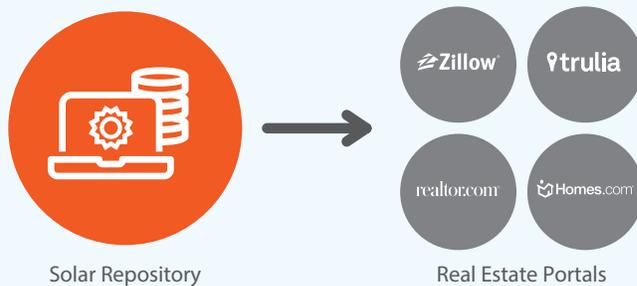
Figure 20 depicts options. The first option shows how solar data could be fed directly to selected portals. The

second option shows how solar data are fed to an MLS (or its tax aggregator). From there, the MLS could incorporate solar data into its existing feed to selected portals.

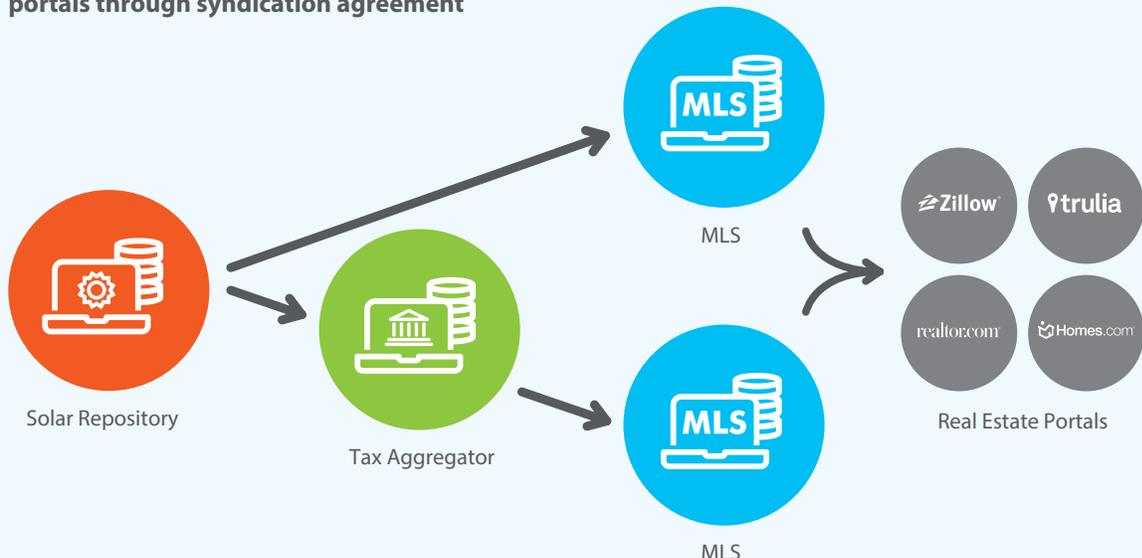
FIGURE 20

Real Estate Portal Import Options

Real estate portals import directly from the existing, publicly funded or solar industry collaborative repository



MLS imports directly from the solar repository or via tax aggregator then provides to real estate portals through syndication agreement



Why not feed data to a portal and then send it to the MLS?

First, it is important to understand the business models behind portals, MLSs, and tax aggregators. Portals earn revenue as an advertising platform for homes for sale. MLSs and tax aggregators earn revenue by assembling and typically licensing property data. MLSs specialize in listing data, and tax aggregators specialize in property records. In practice, listing and/or property records can be used to build advertising records, but not the other way around. So, portals may license data from MLSs and/or tax aggregators, but MLSs and tax aggregators do not license data from portals.

What sort of data set is appealing to a portal?

The largest portals have a national reach. Portals are keen to give consumers access to the same data no matter the location of a home search. Thus portals seek access to a national set of solar data records, or access for all the records in metro areas with the highest number of solar installations.

Do the Roadmap's barrier busters apply to portals?

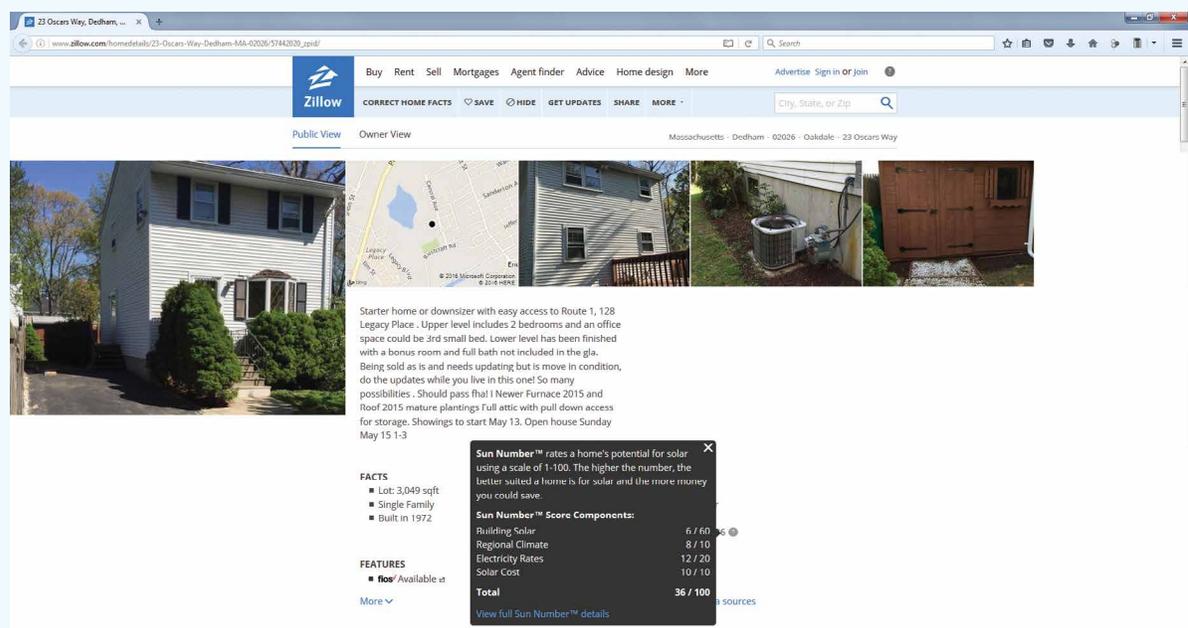
Yes! Portals are already in the business of assembling data from multiple sources for their advertising records.

Consumer opt-in strategies could include portals as possible data-share targets. Journey Leaders pursuing this approach should seek legal advice to understand the ramifications of sharing data as it relates to real estate industry syndication agreements.

Are there options to introduce solar algorithms for portals?

Yes. One of the innovative advancements that established the real estate portal industry is the use of algorithms to use public data and present insights about real estate. The Zillow Zestimate™ is perhaps the most well-known. Zestimate uses public data to provide an estimated property value. Such a tool is known as an Automated Valuation Model or AVM. Recently, portals have been pursuing efforts to create or partner on a new type of estimate tool, an Automated Efficiency Model or AEM. The Council of Multiple Listing Services created a fact sheet related to AEMs (CMLS 2016b). Recently, Zillow released an AEM using public data to calculate and display a Sun Number™ to estimate potential for solar by property. Figure 21 shows an example of the Sun Number in the Boston area.

FIGURE 21
Zillow Sun Number Estimate, Boston



Source: Zillow

Appendix D: Standard MLS Fields Related to Solar Photovoltaic Energy Systems— RESO Data Dictionary 1.5



To accommodate the growing inventory and momentum of residential solar systems, the Roadmap effort included a task to investigate standard solar data fields that might allow buyer and seller to share better information about these systems as well as to share them earlier in the transaction process. The process included consensus review by the Roadmap team as well as from the expert entities listed at the end of this appendix. The results were presented to the RESO Data Dictionary Workgroup. Recommendations were subsequently approved by the RESO board of directors and adopted into the Data Dictionary version 1.5, released in July 2016 (RESO 2016b).

The recommendations follow the three-tiered structure for “Green MLS” fields in the RESO Data Dictionary:

- Third-party verifications
- Generic terms used for general search or marketing purposes
- Details about specific systems in a home

Criteria

The following criteria, defined in the Green MLS Implementation Guide (NAR 2016b), were considered:

Observable: Can be readily identified and verified, ideally by a buyer or buyer’s agent, or, if not, then as part of a standard home inspection or with easily accessible documentation.

Objective: Describes a thing without judgment or opinion; for example, “ventilation,” not “advanced ventilation.”

Attached fixture: A feature or equipment permanently fixed to the property that transfers with ownership; for example, an air cleaner installed into the heating, ventilation, and air-conditioning system is fixed, while a room air cleaner is personal property and is not an attached fixture. *Note that a renewable energy system financed through a lease or PPA is typically considered personal property. However, this personal property can be addressed during the transaction, including appraisal, much like a model home that is sold with the furniture included.*

RESO criteria for adding fields/enumerations were also considered:

Justification: Recommendations in this document are justified based on complications that can arise if details, particularly around size and ownership, are not shared early on in the transaction.

Utilization: Recommendations in this document would have strong utilization based on established and growing inventory of solar installations.

Field At a Glance

Third-Party Verification	Green Search/Mktg	Detailed Fields	Additional Enumerations
<p>GreenBuildingVerificationType</p> <p>GreenVerification[Type]Body</p> <p>GreenVerification[Type]Year</p> <p>GreenVerification[Type]Version</p> <p>GreenVerification[Type]Rating</p> <p>GreenVerification[Type]Metric</p> <p>GreenVerification[Type]URL</p> <p>GreenVerification[Type]Status</p> <p>GreenVerification[Type]Source</p>	<p>GreenEnergy Generation – Solar, Wind</p>	<p>CurrentFinancing – PACE, Power Purchase Agreement, Leased Renewables</p> <p>Electric – Energy Storage Device, Solar PV Seller Owned, Solar PV Third-Party Owned, Wind Turbine Seller Owned, Wind Turbine Third-Party Owned, Pre-Wired for Renewables, Ready For Renewables, Net Meter</p> <p>ElectricOnPropertyYN</p> <p>PowerProductionType – Photovoltaics, Wind</p> <p>PowerProduction[Type]Size</p> <p>PowerProduction[Type] Annual</p> <p>PowerProduction[Type] AnnualStatus – Actual, Estimated, Partially Estimated</p> <p>PowerProduction[Type]Year Installed</p>	<p>Appliances – Solar Water Heater</p> <p>Pool Features – Solar Pump</p> <p>Spa Features – Solar Pump</p>

Specifications

Third-Party Verification Fields: The third-party verification fields (used to represent certifications like USGBC's LEED for Homes, or a score like the HERS Index Score) are shown in Field At a Glance for reference. The last one, GreenVerification[Type]Source, is the only one that applies to PV solar specifically.

GreenVerification[Type]Source: The source of the green data. May address photovoltaic characteristics, or a verified score, certification, label. This may be a pick list of options showing the source (i.e., Program Sponsor, Program Verifier, Public Record, Assessor).

Enumeration	Definition
Administrator	An administrator such as a utility, governmental entity, etc. provided data such as photovoltaic characteristics, or a verified score, certification, label, etc.
Assessor	The assessor provided data such as photovoltaic characteristics, or a verified score, certification, label, etc.
Builder	The builder provided data such as photovoltaic characteristics, or a verified score, certification, label, etc.
Contractor or Installer	The contractor or installer provided data such as photovoltaic characteristics, or a verified score, certification, label, etc.
Other	Data such as photovoltaic characteristics, or a verified score, certification, label, etc. were received from another party not listed.
Owner	The owner provided data such as photovoltaic characteristics, or a verified score, certification, label, etc.
Program Sponsor	The program sponsor provided data such as photovoltaic characteristics, or a verified score, certification, label, etc.
Program Verifier	The program verifier hired as a third party provided data such as photovoltaic characteristics, or a verified score, certification, label, etc.
Public Records	Data such as photovoltaic characteristics, or a verified score, certification, label, etc. were received from public record such as a building permit.
See Remarks	See remarks for information about the source of data such as photovoltaic characteristics, or a verified score, certification, label, etc.

Green Search/Marketing Fields

GreenEnergyGeneration: Methods of generating power that are included in the sale or lease.

Enumeration	Definition
Solar	Renewable form of on-site power generation. Most common are solar photovoltaic (PV) devices which generate electricity directly from sunlight via an electronic process that occurs naturally in certain types of material, called semiconductors. Powers electrical devices or sends electricity to the grid.
Wind	Renewable form of on-site power generation. Wind turbines use wind to make electricity. Powers electrical devices or sends electricity to the grid.

Detailed Fields

Current Financing: A list of options that describe the type of financing that the seller currently has in place for the property being sold, i.e., cash, assumable, FHA loan, etc.

Enumeration	Definition
Leased Renewables	<p>Definition: Renewable system (i.e., solar or wind) belonging to a third party is installed on a customer's property at little or no cost to the property owner. Property owner has entered an agreement to pay for the lease of the equipment.</p> <p>Structure: Fee model is based on equipment to generate power, not power itself.</p> <p>Transfer: If requirements are met it may be possible to transfer lease from home seller to buyer with the approval of the system owner. If being transferred, see Fannie Mae guidelines for more info: since lease is for equipment it must be included in the buyers DTI calculation. If a buyer cannot or will not adopt a lease, then the seller is required to pay the remaining contract amount in full and the system would be removed.</p> <p>Real or Personal Property: Renewable system is typically considered personal property. All tax credits as well as maintenance responsibilities, etc. belong to the third-party owner. Some leases require the homeowner to pay the personal property tax.</p> <p>Terms: Lease should provide items homeowner is responsible for paying. In a solar lease model, a customer will sign a contract with an installer/developer and pay for the solar energy equipment over a period of years or decades. Solar leases can be structured so customers pay no upfront costs, some upfront costs (partially prepaid) or can be fully prepaid (the leasing company is then able to depreciate the equipment over time and offers a lower fee for pre-paid leases). The homeowner may have the option to purchase the system during or at the end of the lease term (most leases are for 20-year terms) at its fair market value or terms set in the original lease contract.</p>
Property-Assessed Clean Energy Synonym: PACE	<p>Definition: Property-assessed clean energy (PACE) is a financing tool for property owners to fund energy or water efficiency or renewable energy installations.</p> <p>Structure: PACE is a secured loan that attaches to the property as a voluntary assessment on the property taxes. To be eligible for a PACE loan, the building must be located in a local jurisdiction where the city or county has passed a resolution to participate in a PACE program. PACE financing is often a public-private partnership between a private finance company and a public agency.</p> <p>Transfer: The loan may be transferred to the new owner upon sale of the property with the approval of the system owner.</p> <p>Real or Personal Property: If seller owns and not a third party, then renewable system is typically considered real property and tax credits and maintenance requirements, etc. belong to the property owner.</p> <p>Terms: Loan terms can vary between 5 and 30 years. Some programs also allow PACE to finance solar leases and power purchase agreements (PPAs).</p> <p>Due to the complexities of PACE financing, NAR and states like California have provided statements which are worth further consideration.</p> <p>NAR - http://www.realtor.org/articles/administration-issues-pace-guidance; CAR - http://www.car.org/newsstand/newsreleases/2015releases/fhapaceliem</p>

Power Purchase Agreement

Definition: Renewable system belonging to a third party is installed on a customer's property at little or no upfront cost to the property owner. Property owner is in an agreement to buy all the power generated at a fixed rate whether it is actually used or not. This is typically lower than the local utility rate.

Structure: Fee model is based on power, not equipment to generate it.

Transfer: A PPA may be transferred to a home buyer with approval from the system owner. If a buyer will not adopt a PPA, then the seller is required to pay the remaining contract amount in full and the system would be removed. If being transferred, see Fannie Mae guidelines for more info: portion of the purchase towards equipment must be included in the buyers DTI calculation.

Real or Personal Property: Renewable system is typically considered personal property. All tax credits as well as maintenance responsibilities, etc. belong to the third-party owner.

Terms: The customer agrees to purchase all energy produced by the system. At the end of the PPA contract term (usually between 10-25 years), property owners can extend the contract and even buy the solar energy system from the developer based on terms in the contract.

Additional info on [SEIA.org](https://www.seia.org).

Electric: A list of electric-service related features of the property (e.g., 110 Volt, 3 Phase, 220 Volt, RV Hookup).

Note: the previous “Electric” field was renamed to DistanceToElectric. More than one may apply.

Enumeration	Definition
Energy Storage Device	Device(s) that capture energy at one time to be used at a later time. Most commonly these refer to single or groups of stand-alone batteries, such as could be used as backup power, but it also might include flywheels or other devices to store power.
Net Meter	Net metering is an electric service that allows electricity generated on a consumer’s site (“on-site”) to offset that consumer’s use. This generation can include (generally small) renewable energy facilities (such as wind, solar power, fuel cells or hydro). Net meters might also be used with energy storage devices such as batteries (stand alone or for electric vehicles). Net meters can “spin backwards” such that at the end of the billing period, the consumer only pays for its use, less what it produced (i.e., the “net”).
Pre-Wired for Renewables	Indicates the electric infrastructure on the property has been extended to more easily incorporate an on-site electric generation facility in the future. This would often include, for example, installing conduit and wire from the generation facility to the electric panel, designating circuits on the panel for that generation, and/or leaving room near the panel for future components, such as an inverter.
Ready for Renewables	Indicates a comprehensive infrastructure is in place on the property to more easily incorporate an on-site electric generation facility in the future. Can be confirmed via supporting documentation such as a checklist provided by the DOE Zero Energy Ready Homes program. Solar-PV ready, for example, would often include extensive efficiency measures such as insulation and appliances, architectural drawings that design for a clear roof space, installing conduit from the attic to the electric panel, dedicated circuits on the electric panel, and leaving room near the panel for future components of a solar electric system, such as an inverter. Local requirements may vary. (Source: DOE Zero Energy Ready Home http://energy.gov/sites/prod/files/2015/05/f22/PV-Ready%20Checklist.pdf)
Solar Photovoltaic Seller Owned Synonym: Solar PV Seller Owned	The electrical features of the property include a solar photovoltaic system that is owned by the seller.
Solar Photovoltaic Third-Party Owned Synonym: Solar PV Seller Owned	The electrical features of the property include a solar photovoltaic system owned by a third party. This is typically a lease but may be some other arrangement where the property owner does not own the photovoltaic system.
Wind Turbine Seller Owned	A wind turbine is provided on the property to generate electricity. Seller owned turbines are typically considered real property and can be transferred with the property.
Wind Turbine Third-Party Owned	A wind turbine is provided on the property to generate electricity. The homeowner enters a lease agreement with the owner of the wind turbine(s). Third-Party Owned turbines indicate a lease or a Power Purchase Agreement (PPA) exists. The lease/PPA can often be transferred but the financing company has to agree. See CurrentFinancing field for important further definition of these models.

ElectricOnProperty YN - Does the property currently have electrical utility available on the property.

DistanceToElectric: If the property does not currently have electrical utility, is service available and if so, what is the distance.

Note: Some properties with renewable systems, especially in remote areas, may disconnect from the grid. The above two fields are important because properties not connected to the grid are not eligible for secondary mortgage market financing. Typically the property would have storage backup options since supplemental power from a utility would not be available on less sunny/windy days.

PowerProductionType: This field is a list of the types of power production system(s) available on the property. The key characteristics of the system are expected to appear as the “[type]” in the related power production fields in a flattened implementation (RETS 1.x only) of the power production fields. A relational implementation of power production must omit the type from the field name and use PowerProductionType to create a vertical representation of the various types of power production available.

Note: PV Solar is the only type of power production currently justified in multiple markets and thus shown. Up and coming renewables that could be added in the future depending on uptake: Wind, Geothermal, Thin Film Solar.

Enumeration	Definition
Photovoltaic Synonym: PV Solar	Solar photovoltaic (PV) devices which generate electricity directly from sunlight via an electronic process that occurs naturally in certain types of material, called semiconductors. Powers electrical devices or sends electricity to the grid. http://www.seia.org/policy/solar-technology/photovoltaic-solar-electric
Wind	Renewable form of on-site power generation. Wind turbines use wind to make electricity. Powers electrical devices or sends electricity to the grid. http://energy.gov/eere/wind/how-do-wind-turbines-work

PowerProduction[Type] Size: The “capacity” of a renewables system. Size is measured in kilowatts (kW) DC (referring to direct current). A kW indicates how much power the system can produce under standard conditions, like the size of a car engine. Renewables systems are sized when they are installed to cover all or a portion of the power needs of the property. Therefore, a system designed to produce 50% of the power needs will be sized smaller than a system on the exact same property designed to produce 100%. Size may be influenced by available space at the property, orientation, landscaping, etc.

Specifications:

- TYPE: Wind or Photovoltaic
- Numeric field: 3 digits + 2 decimal places (e.g., 1.25 or 100.45)
- Units: kW (kilowatts DC)

Future extension to consider (sample below):

- TYPE: Geothermal
- Numeric field: Digits TBD
- Units: Tons

PowerProduction[Type] Annual: The most important metric of a renewables system is the amount of power it

produces per year. This number can be actual or estimated. Annual production for systems producing electricity like wind or solar are measured in kilowatt-hours (kWh) per year. A kWh is like a measure of the distance traveled per hour for a car – how far did it go over a certain period of time. Annual production is influenced by the size and age of the system, the conditions (How shady are the trees? How many cloudy days?), and the installation (panel efficiency). Sellers typically have access to software that provides historical production totals.

Specifications:

- TYPE: Wind or Photovoltaic
- Numeric field: 6 digits - no decimals (e.g., 12000 or 8000)
- Units: kilowatt-hours (kWh) per year

PowerProduction[Type] AnnualStatus: The most important metric of a renewables system is the amount of power it produces per year. This number can be actual or estimated, or a combination if less than 12 months of actual data is available (any missing months of actual data is extrapolated). This field allows the status of the number shown in the PowerProductionAnnual[Type] to be clarified.

Enumeration	Definition
Actual	Annual production derived from 12 or more months of actual data. The most recent 12 months is preferred because systems can degrade, albeit slowly, over time and, more importantly, conditions (e.g., trees) can change. Therefore older data might over- or under-estimate current production amounts.
Estimated	Annual production as estimated at the time or before the system began operation.
Partially Estimated	Production derived from less than 12 months of actual data, and therefore extrapolated to estimate annual production.

PowerProduction[Type] YearInstall: The year a renewables system was installed. Ideally this should be the year the system was interconnected with the grid and began producing power. Renewables systems have a limited lifespan and year installed helps buyers and appraisers determine remaining useful life of the system.

Specifications:

- TYPE: All
- Numeric field: 4 digits (e.g., YYYY)

Additional Detailed Fields: *Definitions currently published in Data Dictionary. Enumerations are proposed only. To be published in a future version of the Data Dictionary.*

Appliances: A list of the appliances that will be included in the sale/lease of the property.

Enumeration	Definition
Solar Water Heater	Solar water heaters are classified as either active or passive, and are usually connected to backup water heaters in case of cloudy weather. Solar hot water systems have different configurations from collecting solar energy and storing and delivering hot water. Solar hot water systems are very different from and should not be confused with solar photovoltaic systems that generate electricity.

Pool Features: A list of features or description of the pool included in the sale/lease.

Spa Features: A list of features or description of the spa included in the sale/lease.

Enumeration	Definition
Solar Pool Pump	A heating system for a pool/spa that heats the water using solar technology. Solar pool heaters are very different from and should not be confused with solar photovoltaic systems that generate electricity.

Subject Matter Experts

The following organizations reviewed the recommendations made to RESO for Data Dictionary 1.5.fields related to solar PV energy systems:

- | | |
|--|--|
| <ul style="list-style-type: none"> ▪ Adomatis Appraisal Service ▪ Appraisal Institute ▪ Build It Green ▪ Center for Sustainable Energy ▪ DOE Zero Energy Ready Home ▪ Elevate Energy | <ul style="list-style-type: none"> ▪ Lawrence Berkeley National Laboratory ▪ Massachusetts Clean Energy Center ▪ Mass DOER ▪ Oldroyd Realty ▪ One Mission Realty ▪ Sustainable Real Estate Consulting Services |
|--|--|

Appendix E: Acronyms and Definitions



Acronyms

AEM	Automated Efficiency Model
AOR	Association of Realtors
API	Application programming interface
CEO	Colorado Energy Office
DC	Direct current
DOE	U.S. Department of Energy
FHA	Federal Housing Administration
HELIX	Home Energy Labeling Information eXchange
HERS	Home Energy Rating System
IOU	Investor-owned utility
kW	Kilowatt(s)
kWh	Kilowatt-hour(s)
LEED	Leadership in Energy and Environmental Design
MassCEC	Massachusetts Clean Energy Center
MLS	Multiple listing service
NAR	National Association of REALTORS
NEM	Net energy metering
PACE	Property-Assessed Clean Energy
POU	Publicly owned utility
PPA	Power purchase agreement
PV	Photovoltaic
RESO	Real Estate Standards Organization
SEED	Standard Energy Efficiency Data (Platform)
SEFA	Solar Energy Finance Association
SEIA	Solar Energy Industries Association
SREC	Solar renewable energy credit
TPO	Third-party owned
UCC	Uniform Commercial Code
USGBC	U.S. Green Building Council

Definitions

Aggregated	Data in which the personal identification is removed by grouping together individual data points and reporting as a summary. For example, all solar data for homes are grouped together by ZIP code and reported as a group average.
Anonymized	Data in which the personally identifying information has been removed or encrypted. For example, in a report that does not contain homeowner name or address of an installation, the individual information is maintained without identifying markers.
API	A set of routines, protocols, and tools for building software applications that specifies how software components should interact.
Contributory value	A type of value that reflects the amount a property or component of a property contributes to the value of another asset or to the property as a whole (Appraisal Institute 2015).
Host owned	Solar system owned by the property titleholder. The system is considered real property at the point of sale.
Installer financed	Solar system owned by the property titleholder but financed by the solar installer.
Kilowatt (kW)	Used to measure the size of a solar system. See system size.
Kilowatt-hours (kWh)	Used to measure the production of a solar system. See system production.
Lease	Arrangement in which a TPO solar system is installed on a customer's property, often at little or no upfront cost to the property owner, with the property owner agreeing to pay for the lease of the equipment. The fee model is based on the power-generating equipment, not the power itself.
Market value	The most probable price, as of a specified date—in cash, terms equivalent to cash, or other precisely revealed terms—for which the specified property rights should sell after reasonable exposure in a competitive market under all conditions requisite to a fair sale, with the buyer and seller each acting prudently, knowledgeably, and for self-interest, and assuming that neither is under undue duress (Appraisal Institute 2015).
MLS	A private offer of cooperation and compensation by listing brokers to other real estate brokers. MLSs are private databases created, maintained, and paid for by real estate professionals to help their clients buy and sell property. The MLS helps listing brokers find cooperative brokers working with buyers to help sell their clients' homes. Without the collaborative incentive of the existing MLS, brokers would create their own separate systems of cooperation, fragmenting rather than consolidating property information (NAR 2016c).
PACE	A financing tool for property owners to fund energy or water efficiency or renewable energy installations. PACE is a secured loan that attaches to the property as a voluntary assessment on the property taxes. To be eligible for a PACE loan, the building must be located in a local jurisdiction where the city or county has passed a resolution to participate in a PACE program. PACE financing is often a public-private partnership between a private finance company and a public agency.

Personal property	The interests, benefits, and rights inherent in the ownership of tangible objects that are considered by the public as being personal. Also called tangible personal property (Appraisal Institute 2015).
PPA	Arrangement in which a TPO solar system is installed on a customer's property, often at little or no upfront cost to the property owner, with the property owner agreeing to buy all the power generated at a fixed rate whether it is actually used or not. The rate is typically lower than the local utility rate. The fee model is based on power, not power-generating equipment.
Production data	Data on the amount of electricity (measured in kWh) produced by a solar system over a given period, usually a year. Also referred to as "performance data."
PV	Technology that generates electricity directly from sunlight via an electronic process that occurs naturally in certain types of material called semiconductors.
Real property	An interest or interests in real estate (Appraisal Institute 2015).
Syndication	Commonly, an agreement between a broker and a third party to advertise the broker's listings on non-MLS websites. The syndication agreement's scope determines how the broker's listings will be displayed on the internet and where the listings will be displayed by the third party (NAR 2016d).
System production	Measure of the energy produced by a solar system, as measured in kilowatt-hours (kWh) over a period of time, often a year (kWh/year). Energy production is influenced by factors such as geographic location, size and age of the system, conditions (shading, clouds, etc.), and system specifications (panel efficiency, panel tilt, etc.). Also known as production, system output, or output.
System size	Measure of the capacity of a solar system, as measured in kW of direct current (kW DC) and is measure of a how much power (energy per unit of time) the system can produce under standard conditions. Also known as size.
Third-party financed	An arrangement in which a solar system is owned by property titleholder but mortgaged by a lender (RESO 2016b).
TPO	A solar system owned by someone other than the property titleholder. The system is considered personal property at the point of sale.

Icons

-  Reflections from the Road: San Diego
-  Reflections from the Road: Massachusetts
-  Reflections from the Road: Colorado
-  Potential Challenge or Roadblock
-  Potential Path Ahead
-  Journey Leader Exercise
-  Roadmap Value for Readers
-  Roadmap Insight for Readers and Partners
-  Further Navigation:
Appendices and Resources
-  Innovation or Technology Insight
-  Investigate: Collect More Information
-  Fork in the Road: Alternatives Ahead
-  Multiple Listing Service
-  Tax Aggregator
-  Repository
-  Orienting the Map: A Framework to Consider

A number of other icons such as these below are used throughout the Roadmap for design purposes only.



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