



February 10, 2015

REPORT #E15-006

Agricultural Irrigation Initiative: Business Case, Economic Modeling, and Market Channel Improvements

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Executive Summary

The precision irrigation market is still in its early stages. Vendors, utilities, and other water- and energy-efficiency-related organizations need to do much more to help growers understand the exact value of precision irrigation for their own farms. Without demonstrated proof of success, many see the adoption of precision irrigation as a risky proposition. Economic tools and models are available to help them project return on investment (ROI); however, using these tools requires time-intensive efforts, and a shortage of trained agronomists precludes scaling this effort for the entire market.

As part of its Agricultural Irrigation Initiative, the Northwest Energy Efficiency Alliance (NEEA) developed a preliminary business case for three different stakeholder groups: growers, vendors, and Northwest utilities. Table 1 outlines the key considerations for each demographic.

Table 1. Stakeholder Groups for NEEA Agricultural Irrigation Initiative Business Case

Demographic	Key Question	Benefits
Demand Side: Growers	Do growers have a compelling reason to adopt precision irrigation solutions?	<ul style="list-style-type: none"> • Lowering water and pumping (energy) costs because non-cropped areas are not irrigated, and applied water is better managed • Reducing fertilizer costs (in situations that use a Variable Rate Irrigation (VRI) system to apply the nutrients) • Decreasing nutrient loss due to leaching and/or runoff • A potential increase in yield by applying “saved” water to previously non-irrigated areas
Supply Side: Vendors ¹	Does a market exist for integrated irrigation solutions, and is a business model available that works for vendors?	<ul style="list-style-type: none"> • Opening up new market opportunities by providing more value to growers with integrated solutions
Northwest Utilities	How will local utilities see a reduction in energy consumption?	<ul style="list-style-type: none"> • New opportunities to engage growers

Note: Table based on NEEA internal discussions throughout the course of this Initiative

This report is one in a series of twelve reports addressing particular areas of NEEA’s Agricultural Irrigation Initiative. All twelve reports are available at <http://neea.org/reports>.

Equipment manufacturers are making new efforts to not only integrate their own products, but to work with other vendors, even competitors, to provide a more complete and seamless solution for growers. That being said, the more complex irrigation technologies, such as Variable Speed Irrigation (VSI) and Variable Rate Irrigation (VRI), require several more years of development

¹ Vendors include manufacturers, consultants, and software service providers.

to facilitate their wide-scale market adoption. A lack of sufficient trained retailers, irrigation consultants, and locally-available agronomists also hampers market adoption.

Even given the above considerations, stakeholder groups can make a case for securing energy savings through more precise irrigation practices in the Northwest. For the immediate future, the Northwest Energy Efficiency Alliance (NEEA) and its utility partners will focus on solutions that can be introduced to the market relatively soon, such as helping growers inspect and “tune up” their center pivots (see the *Pivot Evaluation Best Practices* report) and supporting key technology components, such as common data standards (see the *Data Exchange Standards* report).

1. Introduction

The Northwest Energy Efficiency Alliance (NEEA) is an alliance funded by more than 140 Northwest utilities and energy efficiency organizations in Idaho, Oregon, Montana, and Washington working to accelerate the innovation and adoption of energy-efficient products, services, and practices in the Northwest. This business case report articulates the case for adoption of the NEEA's Agricultural Irrigation Initiative solution by growers, vendors, and utilities. To be attractive to stakeholder groups on both the demand and supply sides, this business case must offer demonstrated proof that using its recommended solution results in lower costs and reduced inputs, specifically lower energy use, along with higher profitability for growers.

The business case includes three tiers of precision irrigation solutions (described below in Section 1.2.4), each of which offers varying degrees of potential water and energy savings. For utilities, the adoption of precision irrigation practices must result in energy savings. Multiple factors impact the business case:

- The target markets themselves
- The value proposition for the target markets
- The reasons for industry stakeholders to participate
- The market dynamics impacting adoption of precision irrigation solutions
- The expected return on investment for utility stakeholders

This business case report is one in a series of twelve reports addressing specific areas of this Initiative, all of which are available at <http://neea.org/reports>.

1.1. Background

According to the Sixth Power Plan (NPCC 2010), agricultural irrigation uses eighty-five percent of the Northwest's agricultural electrical energy and five percent of the region's total electrical energy, which represents a \$335 million annual electricity load. Reducing that load by twenty percent – the goal of NEEA's Initiative – would result in an annual savings of \$67 million.

Precision irrigation practices can reduce water and energy usage.² Although the NEEA team has not quantified the non-energy savings, growers who implement precision irrigation solutions should realize lower costs for seeds and fertilizers, as well as lower associated labor expenditures. Because in-stream water requirements limit the number of acres of irrigated land, increasing water efficiency may allow the development of more irrigated acreage.

Suppliers of precision irrigation solutions have the opportunity to provide new or enhanced products and to expand their markets. Additionally, companies such as Wal-Mart and

² The information in this report is based upon NEEA researchers' observations during this Initiative, on personal experience, and on well-known principles and existing literature. Readers should consider its conclusions advisory/directional rather than applicable to all precision irrigation technologies and stakeholders.

McDonald’s are requiring suppliers to account for sustainability, greenhouse gas emissions, and/or energy efficiency in their processes, labeling, and pricing.

Finally, Washington State’s clean-energy Initiative I 937, passed in 2006, requires large utilities to obtain fifteen percent of their electricity from renewable resources such as solar and wind³ by 2020, in addition to undertaking cost-effective energy conservation measures. Both utilities and end users expect energy prices to increase and are looking for ways to mitigate the impact of such increases.

Given the industry-specific or scientific natures of some terms used in this report, please refer to the [AgGateway AgGlossary \(http://agglossary.org/wiki/index.php/main_page\)](http://agglossary.org/wiki/index.php/main_page) for definitions.

1.2. The Target Market

1.2.1. The Addressable Market

Table 2 below shows the addressable market size, at its broadest level, identified in NEEA’s Ag Irrigation Concept Approval Plan for center irrigation pivots. The strategy to date has focused on farms of one hundred or more acres.

Table 2. Addressable Market for Center Pivots in the Northwest

Region 17 Pacific Northwest	Total Irrigated Acreage	Number of Farms	Percentage of Total
Total Irrigated Acreage	6,855,656	40,017	100%
Total Irrigated Acreage \geq 100 acres	6,237,572	10,306	91%
Total Center Pivot Irrigated Acreage	3,130,726	5,537	46%
Total Center Pivot Irrigated Acreage, factoring out < 100-acre irrigated farms	2,848,470	5,038	42%

Notes: Source – Farm and Ranch Irrigation Survey (USDA/NASS 2007)

1.2.2. Farm Categories

The US Department of Agriculture (USDA) Economic Research Service (ERS) categorizes farms primarily on the basis of Gross Cash Farm Income (GCFI)⁴ (Hoppe, MacDonald 2013). The categories relevant to NEEA’s Agricultural Irrigation Initiative are outlined in Table 3 below.

³ Excluding hydropower

⁴ Gross Cash Farm Income (GCFI) includes the farm’s sales of crops and livestock, receipts of government payments, and other farm-related income. Gross farm sales, in contrast, exclude other farm-related income and include items that are not revenue to the farm: the value of sales accruing to share-landlords and production contractors and government payments accruing to landlords.

Table 3. Farm Types Categorized by Gross Cash Farm Income (GCFI)

Type of Farm	GCFI
Small Family Farms	Less than \$350,000
Mid-Size Family Farms	Between \$350,000 and \$999,999
Large-Scale Family Farms	\$1 million or more
Large Family Farms	\$1 million to \$4,999,999
Very Large Family Farms	\$5 million or more
Non-Family Farms	Not specified

Notes: Non-family farms are defined as any farm where the operator and persons related to the operator do not own a majority of the business. This category includes corporate farms and cooperatives. Sources: (USDA/ERS 2007) (Hoppe and MacDonald 2013).

What a difference a decade makes! The 2001 version of the ERS farm categorization typology categorized Large Family Farms as those with sales between \$250,000 and \$499,999, and Very Large Family Farms as those with sales of \$500,000 or more. However, the shift in farm production to much larger farms compelled the ERS to create the additional category of Mid-Size Family Farms in its updated typology and to switch to the use of much-higher levels of GCFI.

Farms that generate \$250,000 or more in annual sales represent just ten percent of the nation's farms, but they account for eighty-two percent of US food production (Hargreaves 2012). Therefore, farms with higher levels of sales and likely higher levels of energy use may be a source of energy savings potential.

1.2.3. Target Customer

The NEEA Agricultural Irrigation Initiative identified Large-Scale Family Farms and Non-Family Farms as target customers for adopting precision irrigation technologies during the early demonstration phase. These larger farms also consume the greatest percentage of total agricultural energy and are more likely to have the financial resources to invest. Early-adopter Mid-Size Family Farms are also target customers for such irrigation solutions; however, they may need large incentives to motivate purchase.

In addition to the definitions in the preceding paragraph, the target customers have one or more of the following characteristics:

1. They have a requirement or compelling need (either through natural causes or government regulations) to reduce irrigation water use
2. They must manage multiple brands of equipment, in particular center pivots
3. They already have some level of data management on their farms and employ one or more individuals who are dedicated to data management and integration
4. Their overall attitude toward farming technology is forward-thinking

1.2.4. A Range of Precision Irrigation Solutions with Different Costs and Benefits

The NEEA demonstrations tested three precision irrigation technology approaches:

1. Precision Flat Rate (PFR) irrigation is a technology and management practice in which the grower applies a uniform application of water everywhere on the field (also known as flat rate irrigation), and optimizes the irrigation schedule (when to irrigate and how much to apply) to maximize productive output.
2. Variable Speed Irrigation (VSI) is a technology and management practice that manages water application in a spatially explicit manner by varying the speed of the pivot as it moves around the field. The goal of VSI is to increase water use efficiency, improve yields, and maximize profitability by accounting for soil and/or topography variability and then applying the optimal application depths of water both at the right time and in the right place.
3. Variable Rate Irrigation (VRI) is a technology and management practice that manages water application in a spatially explicit manner. Site-specific VRI equips a center pivot irrigation system with the capacity to turn on and off valves for groups of sprinklers on the pivot system, and/or to regulate its speed during operation.

In many cases growers can add precision irrigation capabilities onto their existing center pivot systems, which simplifies their purchase decisions. Even so, the ability of Small Family Farms (see Table 3) to adopt the more complex VRI or VSI solutions remains uncertain due to costs. They would likely opt for less-expensive Precision Flat Rate (PFR) irrigation solutions if they make a change. NEEA, utilities, or vendors may consider surveying Small Family Farm growers to determine their familiarity with precision irrigation solutions and their likelihood of purchase of any such solutions in the next five years.

These technologies are described in detail in the *Irrigation Delivery Systems* report. Choosing one of these technologies is often dependent upon the conditions of a specific farm field. Each of these three approaches has a different potential for grower cost savings (described below in Section 2.1.1) and utility energy savings (described in Section 2.1.3).

2. Overview of Projects/Findings

2.1. Value Propositions

2.1.1. Value Proposition for Growers

Growers who participated in this NEEA Agricultural Irrigation Initiative, either through demonstrations and/or through grower interviews, experienced one area of a field responding differently from another to identical inputs such as seeding, watering, and fertilizing. Until recently, they had few options for remedying these variations. Growers were locked into uniform rates of applications, including water, across entire fields due to limited abilities to alter their application rates. Precision irrigation systems address this problem by allowing the grower to tailor water application to the appropriate amount for each day and/or each part of the field (if the soil has high variability).

Specifically, using precision irrigation technologies can help growers to:

- Reduce the number of pivot rotations (thereby reducing energy consumption)
- Increase their profitability while maintaining yield by reducing inputs, including water and electricity
- Increase yield by using previously-unused portions of a field
- Improve field uniformity and/or crop quality
- Take advantage of cheaper water rate structures from utilities during times of restrictions or demand response events

Based upon findings from the demonstrations, NEEA has projected the probable savings in Table 4 for growers using the various levels of precision irrigation technologies described earlier in Section 1.2.4.

Table 4. Potential Savings for Growers

Uniform and Non-Uniform Fields							
Level 1 SIS		Level 1.1 Precision Flat Rate		Level 2 Automated VSI		Level 3 Automated VRI	
Specification	Incremental Savings Rate	Specification	Incremental Savings Rate	Specification	Incremental Savings Rate	Specification	Incremental Savings Rate
SSURGO Soil Mapping	1%	On-Site Soil Mapping-Texture Grid Topography, SSURGO Mapping Review Grower Knowledge base	2%	On-Site Soil Mapping-EC Mapping w/Texture Grid Topography SSURGO Mapping Review Grower Knowledge base	2.00%	On-Site Soil Mapping-EC Mapping SSURGO Mapping Review Grower Knowledge base	2.50%
Manual-based SIS	3%	Optimal Decision Tool Computer-based SIS	3.00%	Optimal Decision Tool Computer-based SIS	4.50%	Optimal Decision Tool Computer-based SIS	4.50%
Regional weather & ET data within 25 miles		Local Weather & ET (monitored daily) Agrimet Automated updates Located within 5 miles	1.00%	Local Weather & ET (monitored daily) Agrimet Automated updates Located within 5 miles on farm	1.00%	Automated Local Weather & ET (monitored every 6 hrs) located in field	1.75%
None		Yield Mapping (once a season)	1.00%	Yield Mapping (once a season)	1.00%	Yield Mapping (once a season)	1.00%
None		Flow Meter (Daily and or weekly totals) Calibrated to cost per acre/ft.	1.00%	Flow Meter (Daily and or weekly totals) Calibrated to cost per acre/ft.	1.00%	Flow Meter (Daily and or weekly totals) Calibrated to cost per acre/ft.	1.00%
Yes Neutron Probe & Manual "grip test"	2%	Yes Neutron Probe & Manual "grip test"	2%	One Point Monitored for the limiting soil representative location Neutron Probe Service and or electronic remote sensing	3.00%	Three Points monitored, High, Medium and Low Neutron Probe Service and or electronic remote sensing	5.19%
				Automated Remote Control Variable Speed Irrigation System	2.50%	VRI pivot system greater than 3 zones	5.00%
Decision made based on both soil mapping & SIS data	2%	Schedules automatically delivered based on slope, aspect, wind, weekly moisture, ET, yield history. Irrigation log automatic.	2%	Schedules and Rx automatically delivered based on HC Map, real time moisture, slope, aspect, wind, ET, yield history. Irrigation log automatic.	4.00%	Schedules and Rx automatically delivered based on HC Map, slope, aspect, wind, ET, yield history. Irrigation log automatic.	6.00%
Max. Total Incremental Savings Potential	8%		12%	Max. Total Savings Potential	15.20%	Max. Total Savings Potential	21.55%

Note: The savings estimates in this table are based upon NEEA researchers’ demonstrations of developing precision irrigation technologies. The savings projections constitute best estimates due to the small numbers of pivots/fields involved in the demonstrations and to variations among fields and irrigation systems.

2.1.2. Value Proposition for Vendors

Irrigation equipment suppliers, specifically pivot hardware vendors, are motivated to find new streams of revenue by providing new applications that can make their more expensive irrigation pivots more attractive to growers.

Field sensor and instrumentation manufacturers are looking for both increased revenue by selling more units and for the creation of ongoing revenue streams.

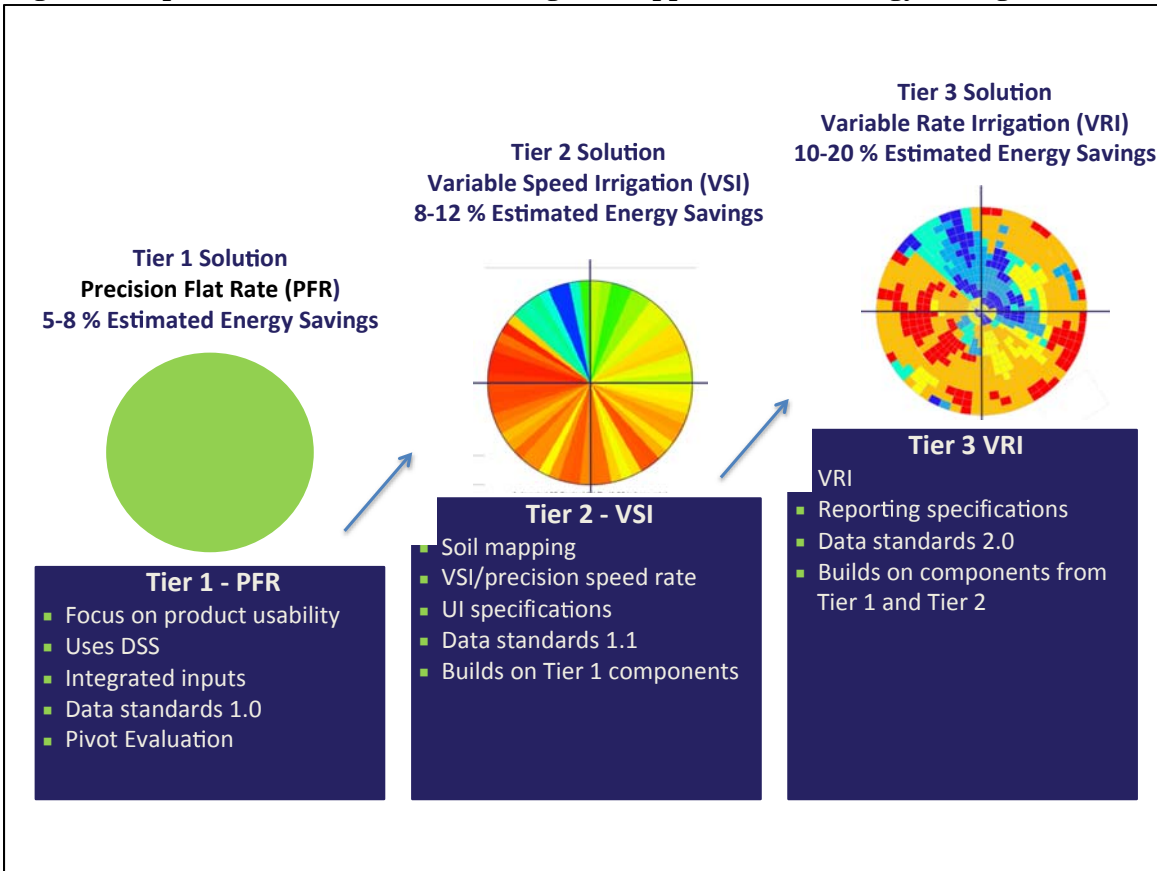
Third-party application developers and data warehouse firms are keen to provide software support and services to help growers collect, store, and manage farm operations data, including irrigation data. In some cases, their business models depend on partnering with hardware manufacturers; in others, they work directly with growers and irrigation consultants.

Irrigation consultants look to expand their client bases as they take on roles as trusted advisors to growers who are beginning to see the value of more efficient irrigation.

2.1.3. Value Proposition for Utilities

NEEA’s 2012-2014 demonstrations did not provide enough specific, scientifically rigorous, quantifiable energy reduction data to create a proven product for a utility incentive program. Challenges included problems isolating the energy usage impact to a single pivot or field, and difficulties obtaining confidential energy usage data for specific farms. However, noting actions such as reducing the number of pivot turns allowed NEEA to estimate the potential energy savings of each of the three precision irrigation approaches. Figure 1 below shows the potential energy savings for these tiered approaches and how each approach builds on the previous one.

Figure 1. Impact of Different Precision Irrigation Approaches on Energy Savings



2.2. Market Forces

2.2.1. Precision Irrigation Is Still Fairly New to Growers

The concept of precision agriculture has been around since the early 1980s, although precision new technologies really began to take off in 2003 when growers could begin to use Global Positioning Systems (GPS) to map specific field locations. In 2006, the PrecisionAg Institute surveyed early-adopter growers in the Midwest and South about the cost savings they had accrued by using a variety of precision ag technologies. Table 5 below shows that those 2006 grower respondents considered savings from precision irrigation “not applicable” for all three crops about which they were asked, indicating that growers were not yet commonly using precision irrigation.

Table 5. Adoption of Precision Irrigation Lags Other Precision Ag Applications
Average Input Savings/Acre

Precision Ag Technology	Corn (n=20)	Soybeans (n=20)	Cotton (n=26)
Seed	\$3.00	\$2.00 - \$3.00	\$1.00 - \$15.00
Fertilizer	\$5.00 - \$13.00	\$4.00 - \$9.00	\$1.00 - \$20.00
Herbicides	\$1.00 - \$3.00	\$2.00 - \$3.00	\$2.00 - \$20.00
Insecticides	\$2.00	\$1.00 - \$2.00	\$3.00 - \$5.00
Fungicides	\$1.00 - \$2.00	\$1.00 - \$2.00	N/A
Irrigation	N/A	N/A	N/A
Time	\$2.00 - \$3.00	\$1.00 - \$3.00	\$2.00 - \$10.00
Labor	\$1.00 - \$3.00	\$1.00 - \$3.00	\$1.00 - \$8.00
Plant Growth Regulators	N/A	N/A	\$2.00 - \$15.00

Note: Source – Nowels 2006

2.2.2. Barriers to Market Adoption and Interventions to Overcome Them

Perceived risk is the greatest barrier to adoption of precision irrigation solutions. The reward from adopting precision irrigation must be clear in the grower’s mind. Merely lowering the price of a precision irrigation solution is unlikely to remove the perception of risk. Growers who participated in the NEEA demonstrations talked about three kinds of risks:

1. Adoption Risk: The precision irrigation solution may not be useful or may not deliver a return on investment (ROI) because the payback is not substantial enough.
2. Solution Risk: The precision irrigation solution may not be supported or sustained because it is hard to install and use, or because it otherwise does not integrate with existing field practices. Worse yet, it may decrease the grower’s yield or profitability.
3. Privacy Risk: The grower’s data might be sent to a third party (such as the government or a major agricultural firm) that would use the data for its own purposes.

2.2.3. Market Interventions

Although growers would benefit from adopting precision irrigation solutions, key barriers still exist. Table 6 lists several interventions that NEEA identified to help overcome market barriers and drive successful outcomes; it summarizes, among other actions, some means through which the availability of an easy-to-use, well-integrated set of technologies can help market adoption.

Table 6. Overcoming Market Barriers

MARKET BARRIERS	INTERVENTIONS	OUTCOMES
<ul style="list-style-type: none"> ▪ Lack of cost-effective, easy to use, integrated products ▪ Perceived lack of value for cost ▪ Lack of awareness and knowledge among growers and vendors of energy-efficient irrigation practices ▪ Cultural resistance to change 	<ul style="list-style-type: none"> ▪ Develop an easy-to-use, integrated solution ▪ Standardize definitions, tools and methodologies ▪ Prove the business case through accepted proof points ▪ Educate, train and/or certify growers and market actors to use integrated irrigation management systems 	<ul style="list-style-type: none"> ▪ Growers and market partners aware of and value integrated irrigation management products ▪ Products/services available and broadly adopted ▪ Agreed upon standards in use ▪ Growers and market partners have technical skills and expertise to use, sell, and support the product effectively

2.3. Economic Models

An economic model is a framework designed to show complex economic processes. In the case of the NEEA Agricultural Irrigation Initiative, an economic model provides detailed financial analyses to help growers determine whether investment in a particular irrigation solution can make them more profitable. Oregon State University conducted a case study and determined that the benefits of decreased energy use outweigh the costs of hiring a consultant to monitor irrigation scheduling. Further, the case study showed for a particular farm in Hermiston, Oregon that a deficit irrigation scheduling program could generate an additional \$89,509 net income over ten years with only marginal changes to existing financial ratios and performance (OSU/AgTools 2013).

Growers can use various online tools, or work with agronomists, to create a specific economic model for their farms. The model enables growers to evaluate how changing production practices, such as irrigation, can change their crop and whole-farm profitability, financial ratios, and performance measures. However, the effort is often time-intensive and involves sensitive information. Typically, growers need to provide projected yields, prices, and input costs for each of their anticipated crops for the affected crop year.

2.4. Results from 2014 Demonstrations

Yield and profitability results from the 2014 NEEA demonstrations will be available in early 2015; however, the results may in some cases be more anecdotal than quantitatively sound due to limited sample sizes. For more information, please see the *Irrigation Delivery Systems* report.

One of the most promising components of NEEA’s Agricultural Irrigation Initiative consisted of an initial investigation into the economic benefits of growers inspecting and “tuning up” their center pivot irrigation systems. This work is detailed in the *Pivot Evaluation Best Practices* report. While the evolving nature of the pivot evaluation process meant that the study produced no conclusive findings, it justifies continued scanning on NEEA’s part of this approach as a way to acquire near-term energy savings in the agricultural sector.

3. Market Channel Improvements

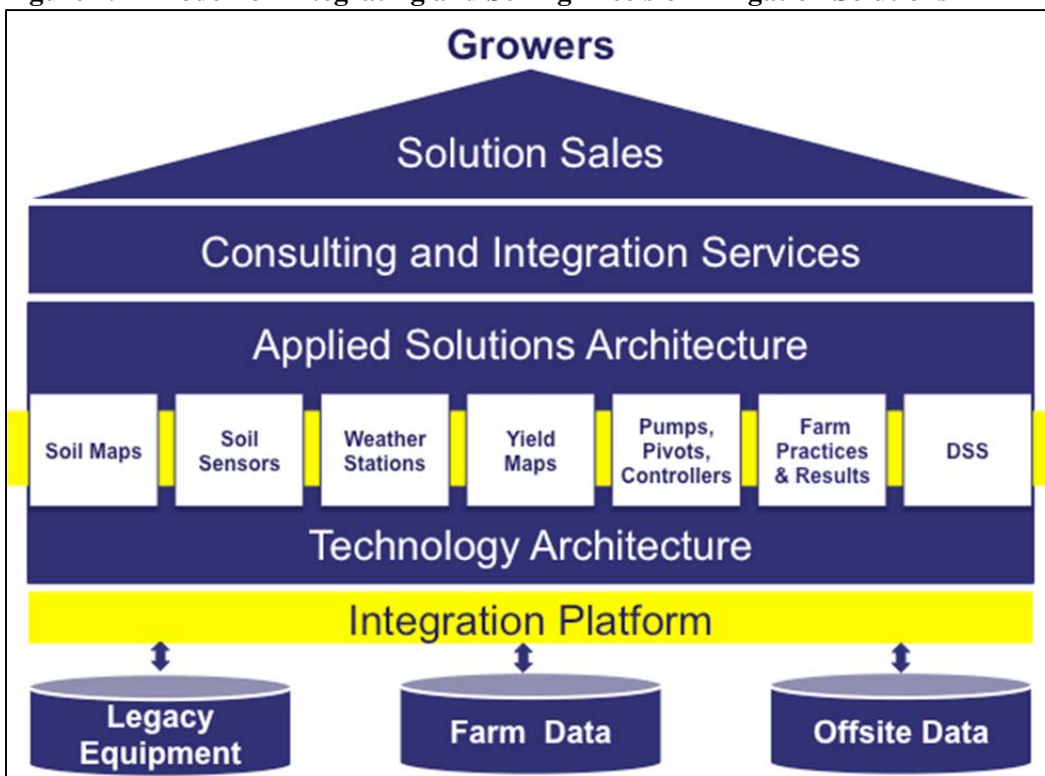
3.1. This Market Channel Is Complex

Business consultant and author Geoffrey Moore distinguishes between making and selling “widgets” and making and selling integrated solutions, calling the former “high volume” and the latter “complex systems” (Moore 2008). Some high-volume products, such as energy-saving light bulbs and residential insulation upgrades, are fairly simple to understand and easy to sell to consumers. In contrast, precision irrigation solutions require many different players to come together to develop and sell a complete solution to growers.

Developing and marketing precision irrigation solutions are not simple matters; these solutions cannot just be placed on a shelf and sold like individual sensors or sprinkler heads. Complex solutions such as these require the integration of many moving parts. If those parts are not all under the control of a single entity, such as a company or agency, getting them to all work together (also known as vertical integration) becomes very challenging.

Figure 2 below shows an adaptation of Geoffrey Moore’s model for a complex system as applied to precision irrigation solutions.

Figure 2. A Model for Integrating and Selling Precision Irrigation Solutions



Note: Source – adapted from Moore 2008

The precision irrigation market model in Figure 2 is organized around the grower, at the top of the model. Market success is dependent upon a relatively small set of customers making relatively large purchase commitments. Growers typically have the power in sales negotiations, and solutions must be customized to fit within their existing farm management processes and equipment infrastructures. No two solutions are identical, and lead times are long.

Precision irrigation solution sales are driven from local sales sources such as irrigation equipment retailers or irrigation consulting services (the two levels directly below Growers in Figure 2). In some cases, the irrigation consultants may be directly associated with a particular pivot manufacturer or irrigation services provider; their role is to bridge the specific needs and requirements of the grower and the core capabilities of the precision irrigation solution.

As part of the support for the solution sales, the applied solution architecture (see Figure 2) helps the grower understand how all of the parts of a precision irrigation solution come together. It helps bring all of the different pieces of information that the grower needs into a common view. It includes the user interface, as well as system sales instruction and training.

The role of the integration platform (outlined in yellow in Figure 2) is to tie together all of the separate pieces that make up the precision irrigation system. These pieces include hardware, such as sensors, soil maps, and pivots, as well as information and decision support systems (DSS). These elements, all working together, can generate irrigation schedules and report the results. The system must also integrate with (or replace) the farm's current hardware and software systems. Finally, it must also connect with other Farm Management Information Systems (FMIS), such as off-site weather data or equipment specifications from manufacturers.

The technology architecture includes common protocols such as the Precision Ag Irrigation Leadership (PAIL) data standards (for more on this, see the *Data Exchange Standards* report). It may also include common application programming interfaces (APIs) and data transfer mechanisms such as telemetry systems. The technology architecture enables the addition of new products and services without having to reconstruct everything from the ground up.

3.2. Needed Improvements in the Value Chain

As noted above, market adoption of precision irrigation solutions requires coordination of different technologies, information, and processes through a value chain (a term used to describe the set of companies, organizations and alliances that collectively create value for the grower). No one member of the value chain can deliver all necessary products and services end-to-end. The value chain strategy of aligning with partners and allies is currently taking place in the precision irrigation market with the goal of creating more seamless solutions for growers. This trend should continue.

A group of vendors working on the PAIL project referenced in Section 3.1 met in January 2014 and evaluated the current ability of the market to deliver complete precision irrigation solutions to the market. The group identified three key gaps:

1. Lack of a trained retail force constitutes the single biggest gap in the market channel. Dealers are trained and equipped to sell products, not necessarily to sell solutions that are coming into the market quickly. Their margins are typically based on hardware, not solutions
2. Lack of trained agronomists to help growers calculate the return on investment when purchasing precision irrigation equipment and services
3. Lack of trained irrigation consultants to guide growers on the best use of precision irrigation technologies

These gaps together indicate that growers currently lack a single source of information and guidance for precision irrigation solutions, which thus remains a key barrier to market adoption.

4. Risks and Challenges

4.1. Risks

Growers are interested in the cost savings and yield-increasing potential of precision irrigation, but do not want to take on the risk of new solutions until they have some proof that they work. They often look to their neighbors for this proof. The cost and intricacy of precision irrigation solutions present a risk that the more complex delivery systems, such as VSI and VRI, will be purchased only by a relatively small set of early-adopter growers. This risk is particularly real in the Northwest, where water and energy costs are often minimal factors in the grower's overall budget.

Because growers talk to one another when considering new purchases, the impact of one grower sharing one "bad" experience would be much greater than the impact of several growers sharing "good" experiences.

4.2. Challenges

The market for precision irrigation solutions relies upon a complex model of interdependent partnerships and technology integrations. Individual companies are now beginning to see the value of these partnerships and of ceding some of their proprietary information in order to deliver higher-value solutions to their customers. However, the levels of planning, development, and execution required across the wide range of instruments and data necessary to ensure easy integration into current farm practices takes considerable coordination and sustained effort.

The industry faces a huge hurdle in trying to scale up the ability for growers to assess the return on investment for new precision irrigation equipment or services. Making such purchase decisions with any level of confidence takes time and expertise. The development of easy-to-use online assessment tools may help to alleviate this challenge, provided they facilitate simple and efficient analysis.

Isolating energy savings to a change in irrigation practices on a single farm, much less on a single field, is very difficult. Electrical lines feeding a pivot often share other duties such as lighting a large storage shed or a workshop. Using an average energy amount per pivot rotation may serve as a proxy in calculations of energy savings acquired through precision irrigation practices.

5. Lessons Learned, Next Steps, Value of Findings

5.1. Lessons Learned

The precision irrigation market is entering a new phase of maturity in which hardware, software, and consulting solutions are just beginning to come together to provide value for growers. Vendors are making great strides in providing more seamless solutions.

While some of the more complex technologies such as Variable Speed Irrigation and Variable Rate Irrigation require more development, some closer-in technologies, such as Precision Flat Rate irrigation, merit consideration as market-ready solutions. Implementing smaller incremental steps, such as performing pivot tune-ups, may provide real, near-term energy savings.

As growers are introduced to precision irrigation success stories, they will begin to adopt these solutions – as long as they are customized to their needs and can be slowly integrated into their existing farm management practices.

5.2. Next Steps

NEEA will pursue additional research into quantifying the energy savings that can be achieved based upon the findings from the pivot evaluation study (detailed in the *Pivot Evaluation Best Practices* report). NEEA and the utilities could use those findings as the basis for a multi-year road map for increasing energy savings in the industrial agricultural sector, as the precision irrigation technologies mature and the manufacturers continue to integrate market offerings.

5.3. Value of Findings

NEEA can make a clear business case that precision irrigation solutions provide real benefits to growers in the Northwest. This Initiative initially assumed that the technologies were mature enough for greater market adoption. The findings from the studies and demonstrations in this Initiative, however, have shown NEEA that a tiered approach to market adoption is much more likely to succeed in achieving real energy savings.

6. References

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