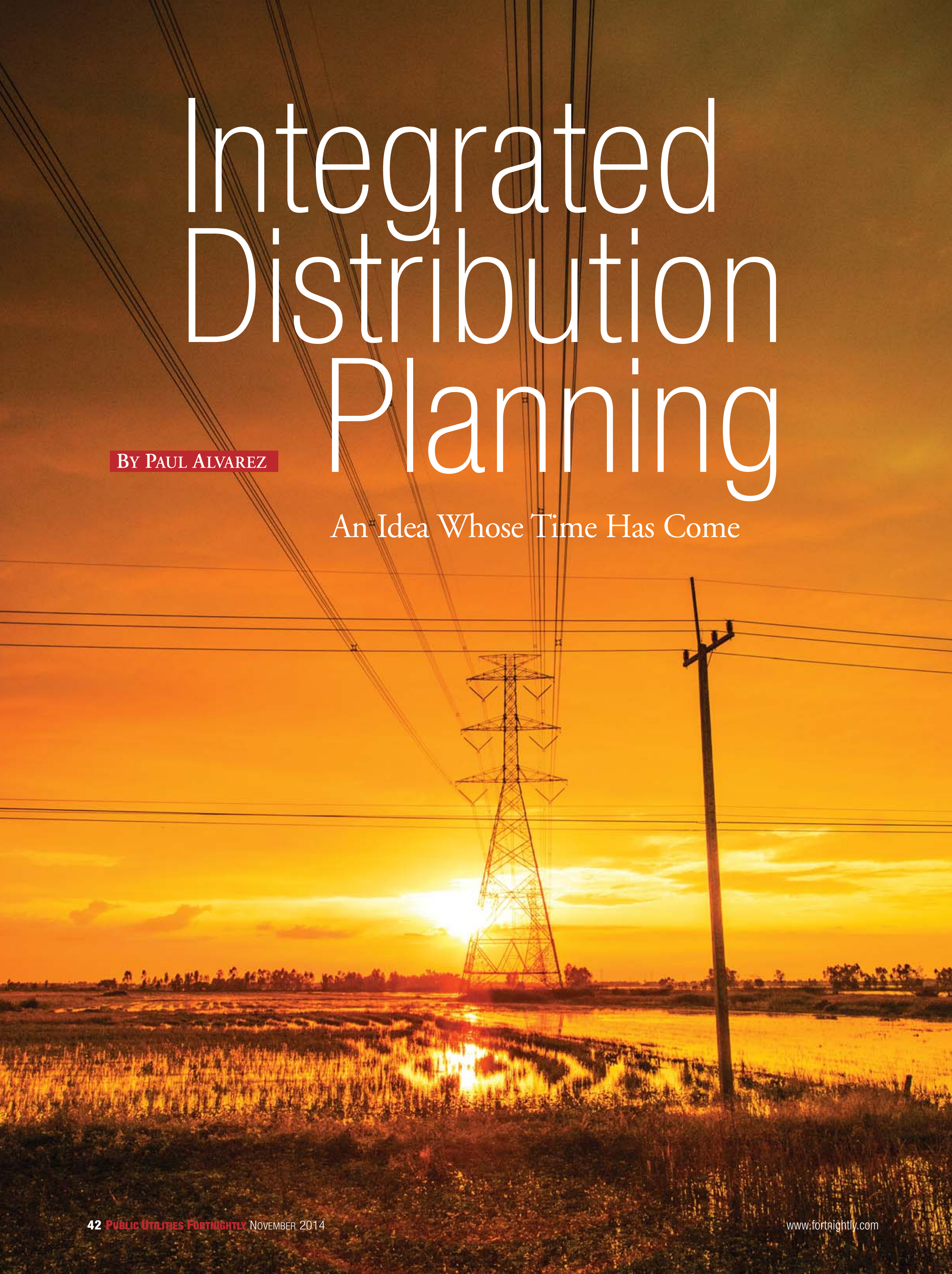

Integrated Distribution Planning

An Idea Whose Time Has Come

By Paul Alvarez

For decades now, most states have required Investor-Owned Utilities (IOUs) to file periodic plans describing least-cost, least-risk approaches for meeting anticipated future loads. Though many restructured states have replaced "Integrated Resource Planning" with "Procurement Planning," the goal is essentially the same: complete a public process to help assure regulators (and other stakeholders) that low-cost electricity will be reliably available to customers when needed. More recently, integrated resource planning (IRP) has also been used to accomplish other ostensibly worthwhile goals, such as renewable portfolio standards, with as little cost and risk to customers as possible. To date, however, integrated resource plans have focused almost exclusively on electric generation options, including consideration of related issues such as transmission and demand-side management potential, capabilities, and costs.

This article proposes to apply integrated resource planning principles to distribution grid modernization. Using IRP goals, processes, and characteristics as a guide, readers will recognize the potentially significant value of *Integrated distribution planning* (IDP) in reaching future customer, community, and societal goals in the most cost-effective and low-risk manner possible. We'll begin by looking at the changing role of distribution grids and modern distribution grid investment characteristics. We'll also consider a potential framework for an IDP process and its likely value to community planning and development stakeholders.

The Case for Change

As the roles evolve that distribution grids (and utilities) will be asked to play in the future, the characteristics of required investments (and planning) will (should) change too. Before the recent grid modernization gold rush, the capital a utility might request for its distribution grid in a rate case might have amounted to $100 per customer. Today, a utility's comprehensive grid modernization proposal might amount to $2,000 per customer *or more*. Historically, customers demanded that distribution grids reliably accommodate 1-2% load growth annually; today, stakeholders are demanding that distribution grids meet a variety of customer, community, and societal goals, each presenting its own challenges and many in conflict with others:

- **Choice.** Accommodate ever-greater customer choice, including self-generation, electric transportation, microgrid, payment, and pricing options
- **Reliability.** Maintain or enhance reliability, including reduced vulnerability to cyberattacks and severe weather
- **Efficiency.** Increase the energy efficiency of the distribution grid
- **Cost.** Remain economically viable/maintain low capital costs while holding rates down during times of falling sales volumes.

If the dramatic changes in distribution grid and utility roles aren't enough to prompt a new approach to distribution planning, perhaps the uncertainty associated with future customer technologies is. How might convenient, cost-effective energy storage change the distribution grid and utilities? What about the connected home and the internet of things relative to demand response and real-time pricing? The timing and extent of customer generation and electric vehicle adoption? These 'known unknowns,' not to mention the 'unknown unknowns,' threaten to make IRP modeling look simple by comparison.

Self-generation, the connected home, the internet of things – they all warrant a new approach to planning.

Also consistent with resource planning, grid modernization presents a dizzying array of design alternatives presenting different types and levels of attractiveness depending on one's priorities (cost reduction, risk reduction, reliability, flexibility, environmental impact, customer choice, etc.). Smart meter communication network choices alone probably number in the dozens, each with its own pros and cons on a variety of measures:

- **Networks.** Build a dedicated network or buy network services from available service providers?
- **Meters.** Support the use of meters as home energy management gateways? Or leave to private sector?
- **Privacy.** Make customer usage data available in near real time? For individual queries or 'en masse'?
- **Services.** Provide communications infrastructure for multiple utilities/services? Or for other city services, from Police and Fire to Parks & Recreation and Facilities Management?

These issues are summarized in Figure 1, p. 44. Readers

Paul Alvarez is the President of the Wired Group and author of "Smart Grid Hype & Reality: A Systems Approach to Maximizing Customer Return on Utility Investment." He can be reached at palvarez@wiredroup.net.

FIG. 1 DISTRIBUTION INVESTMENT CHARACTERISTICS, HISTORICAL VS. MODERN

Characteristic	Historical Distribution Investments	Modern Distribution Investments
Investment Requested	Small ($100 per customer)	Large ($2,000+ per customer)
Investment Objective	Reliably accommodate 1-2% annual load growth	Accommodate a variety of customer, community and societal goals
Future Operating Environment	Highly certain	Highly uncertain
Design Alternatives	Few	Many

FIG. 2 SAMPLE ROADMAP METRICS, TARGET VALUES, AND TIME FRAMES

	Short Term	Moderate Term	Long Term
Resiliency	Catastrophic event: 100% restoration in 5 days	Catastrophic event: 100% restoration in 4 days	Catastrophic event: 100% restoration in 3 days
Reliability	99.96%	99.98%	99.99%
Customer Efficiency*	Average head-end voltage 120v/circuit	Average head-end voltage 117v/circuit	Average head-end voltage 114v/circuit
Capital Efficiency	Callable demand response should be at least 3% of peak	Callable demand response should be at least 6% of peak	Callable demand response should be at least 10% of peak
Customer Choice^	Accommodate distributed generation capacity of up to 50% of minimum recorded demand per circuit	Accommodate distributed generation capacity of up to 100% of minimum recorded demand per circuit	Accommodate distributed generation capacity in excess of 100% minimum recorded demand per circuit
Economic Sustainability	Distribution rates in lowest 50% of utilities	Distribution rates in lowest quartile of utilities	Distribution rates in lowest decile of utilities

* With no increase in customer voltage complaints ^ While simultaneously achieving the reliability targets

familiar with the integrated resource planning process will recognize the similarities to "Modern Distribution Investment" characteristics right away.

A Potential Framework

Having made the case that a new approach to distribution planning is long overdue, a framework for an IDP process is presented for consideration. Like resource planning, most communities will be well-served by updating an IDP periodically, perhaps every 3 years. The proposed IDP development framework includes visioning, roadmapping, and business planning.

Visioning. In the visioning step, stakeholders are encouraged to take a 15-20 year view of a community's distribution grid and utility while answering a half-dozen questions:

- What roles will our distribution grid and utility play in our community's economic and environmental sustainability?
- What economic and technical developments are likely in customer technologies (generation, storage, loads, controls, microgrids, etc.)?
- What is the value of customer choice relative to developments in customer technologies?
- What economic and technical developments in grid technologies are likely?
- What threats (weather, cybersecurity, economic) are our grid and utility likely to face?
- What changes in distribution grid and utility capabilities are we likely to need?

The answers should be captured in a document that translates educated guesses into potential and desired future states for a community, its (electric) energy needs, and associated grid/utility capabilities. 'Collaboratives' formed to develop a grid vision in several states (in particular Illinois, Kentucky, and New York) are a step in the right direction, but as one-time events without further role or responsibility, their value is limited. Ideally, a grid vision is periodically updated and serves a specific purpose: to help stakeholders prioritize focus areas to develop in more detail as part of a grid modernization roadmap.

Roadmapping. With agreement on a vision, the IDP takes shape in greater detail through roadmapping. Roadmaps consist of short-term (1-4 years), moderate term (5-10 or so years) and long-term (beyond) outlines for the evolution of a community's grid and utility over time. Ideally, roadmapping should include some high-level cost estimates to assist with prioritization and trade-offs. In summary, it specifies the methods by which a

FIG. 3 SAMPLE COMPONENTS OF A REQUIREMENTS DOCUMENT

Requirement	Rationale
Two financially sound suppliers shall be secured for each technology component	Interoperability keeps selected suppliers on their toes and reduces obsolescence risk
Proprietary/niche solutions shall be avoided in favor of open-standard, proven solutions	Reduces obsolescence risk, demands pragmatic design choices, and encourages competition for utility and customers' business
Increased customer choice (rate options, self-generation, energy management, etc.) has value and should be considered in business plans	Helps maximize the flexibility inherent in grid modernization designs and better prepares the grid for an uncertain future
All purchases should be warranted by their suppliers for at least 5 years	Transfers some economic risk from communities to suppliers
Distribution rate increases should be kept to no more than 1.5% annually	Ensures cost-effective capability prioritization and supports community economic development

community plans to achieve as much of the vision as possible with as little cost and risk as possible. While a vision may be aspirational in nature, a roadmap is much more practical. Ideally, the roadmap specifies objective performance metrics and target values for each timeframe, offering a yardstick by which to measure progress toward the vision.

Roadmap development is also the part of the IDP process in which stakeholders should agree upon other specifications, strategies, and features, including secondary goals and requirements. These issues can be captured in what is known in product development parlance as a *requirements document*. Some sample components of a requirements document are provided in Figure 3.

In summary, the roadmap provides the goals, objectives, strategies, and requirements utilities (and other stakeholders) can use to guide business planning.

Business Planning. A business plan puts meat on the bones of the short-term component of the roadmap, providing details on costs, capabilities, benefits, schedule, and fit with the priorities established in the vision and roadmap. The business plan is technology and supplier centric, including a great deal of RFI and RFP work. As this is a utility's area of expertise, the bulk of business plan work falls to it. But stakeholders must remain actively involved, ensuring business plans are consistent with the vision and roadmap, maximize bang for the buck, and incorporate post-deployment activities critical to capability optimization. It's particularly important that business plan, capability, and technology choices do not constrain future options or inhibit roadmap/vision attainment. A strong business plan incorporates all of the following components at a minimum:

- A business case with a positive customer NPV (the present value of direct economic benefits exceeds the present value of capital and related operations and maintenance spending)
- Details of new capabilities and their relative contributions to roadmap metric achievement
- An implementation project plan detailing deployment schedules, monitoring and control procedures, organizational changes, and other activities designed to ensure anticipated capabilities are delivered within budget in a timely manner
- A detailed post-deployment action plan illustrating how the utility plans to optimize the direct economic, environmental, reliability, and customer choice benefits of new capabilities through innovation, operational change management, and customer programs.

The unknowns – both known and unknown – make resource planning look simple by comparison.

Potential Value

Customers, communities, and utilities all stand to benefit from an ongoing IDP process and associated updates.

Customers. "Average" customers stand to gain more than others from an IDP process. While low-income customers are represented by consumer advocates, and large commercial and industrial customers have the motivation and wherewithal to advocate their positions, the average customer's interests are not well-represented in today's litigious rate case and grid modernization proceedings. It's possible an IDP process could better address typical customer needs, wants, and priorities. It's also likely a formal IDP process would deliver greater economic, reliability, and customer choice benefits per dollar for the average customer.

Communities. Grid modernization stakes are high. A community's grid will have a disproportionate impact on its future economic and environmental sustainability. While advocates of the environment and distributed generation are typically well-organized and focused, the plates of elected local and state officials are full and focused on short-term issues. Grid modernization merits a place at their tables. In some states and communities, legislators are guilty of abandoning critical grid planning activities to utilities. At the other extreme, well-intended but under-informed grid legislation can pre-empt any IDP process and its potential benefits entirely. A formal IDP process, by virtue of its “many heads are better than one” nature, is likely to deliver greater community value per dollar than either “hands off” or “hands on” legislative approaches.

Utilities. It is understandable that utilities – both for profit and nonprofit – would prefer to maintain complete control over grid investment choices. But the reality is that the choices utilities are making today will affect customers and entire communities for decades. This, in addition to the fact that customers and communities ultimately pay for these investments, makes it highly appropriate that decision rights be shared. But after giving it some thought, utilities will likely recognize a prudent motivator – risk management – for sharing decision rights beyond the perfunctory ‘it’s the right thing to do.’

In environments characterized by significant future uncertainty, the likelihood that decisions made today will be correct is very small. By holding tightly to decision rights, utilities increase the probability that their choices will be second-guessed -- quite possibly to their economic detriment – in the future. If choices made today are likely to be judged in the future, better that the choices be made with the documented input and support of stakeholders. Looking back from some future date, utilities will reduce stranded asset risk by being able to categorize grid modernization decisions as “community” choices rather than utility choices.

An IDP process also reduces customer satisfaction risk. As it is impossible for utilities to satisfy all stakeholders, it is difficult for utilities to be perceived as anything but an enemy of all stakeholders. A properly-executed IDP process forces stakeholders to educate themselves, compromise, and agree upon future directions. An IDP process could take the guesswork regarding “what’s best for our community” out of utility and/or regulatory hands. In an IDP process, a utility’s role shifts from bad guy to subject matter expert/consultant/educator. Consider the significant difference in the following phrases:

- “Here’s what we propose to do.”
- “If the community agrees it wants to prioritize (fill in the blank), there are really 3 ways to go about it. Here are the pros and cons of each approach.”

Addressing Utility Disincentives. This article has illustrated the need for IDP, presented an IDP process strawman for consideration, and described the potential value propositions of IDP for customers, communities, and utilities. It is quite possible IDP would result in better grid investment choices than a utility acting on its own, but there is another critical aspect to maximizing customer and community return on grid investments: ongoing utility operations.

Unlike traditional grid investments, in which there is a fairly direct correlation between grid investment and customer value (reliability), modern grid investments generally deliver new capabilities. The optimization of those new capabilities is far from assured. In fact, optimizing those capabilities to their fullest extent requires extensive policy changes to utility programs and operations that are not necessarily encouraged (and in fact are often discouraged) by traditional ratemaking practices and regulation.

With so much uncertainty, decisions made today may likely prove incorrect.

For example, my teams’ primary and secondary research indicates that about one-thirdof the direct economic benefits in an optimized smart grid deployment stem from energy conservation. Unfortunately, most utilities are discouraged from reducing energy sales volumes by traditional ratemaking processes.

Going forward, the RIIO model being implemented in the U.K., the New York PSC’s “Reforming Energy Vision” docket, and Maryland’s “Utility 2.0” initiatives all hold promise for addressing disincentives. And communities considering grid modernization investments are strongly encouraged to consider changes to regulatory and governance models as part of IDP. But that is a subject for another day.