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NATIONAL RENEWABLE ENERGY LABORATORY



Integrated Deployment Model: A Comprehensive Approach to Transforming the Energy Economy

Mary Werner

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Technical Report
NREL/TP-7A20-49230
November 2010

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Integrated Deployment Concept

The National Renewable Energy Laboratory (NREL) has developed a comprehensive energy deployment approach that addresses the entire energy system for any given location. The model, which NREL calls Integrated Deployment, has been developed and used at several locations, including cities, states, federal agencies, and island nations. To date, the model has shown to be successful at any level and size as long as the major decision makers and political leaders are committed to the effort.

The mission of Integrated Deployment is to accelerate market adoption of alternative energy solutions to power homes, businesses, and vehicles through a comprehensive and aggressive approach. To address the complex challenges of the multi-technology, multi-stakeholder, multi-fuel deployment problem, NREL created a process that supports each technology area separately but also looks at the integration points between the technologies. NREL also identified the cross-cutting components necessary for successful deployment of technology solutions. Those components are critical to connect the technology solutions to the market. The last component is the partners necessary to implement change. Figure 1 illustrates the integration of technology and deployment components with partners to create the Integrated Deployment model.

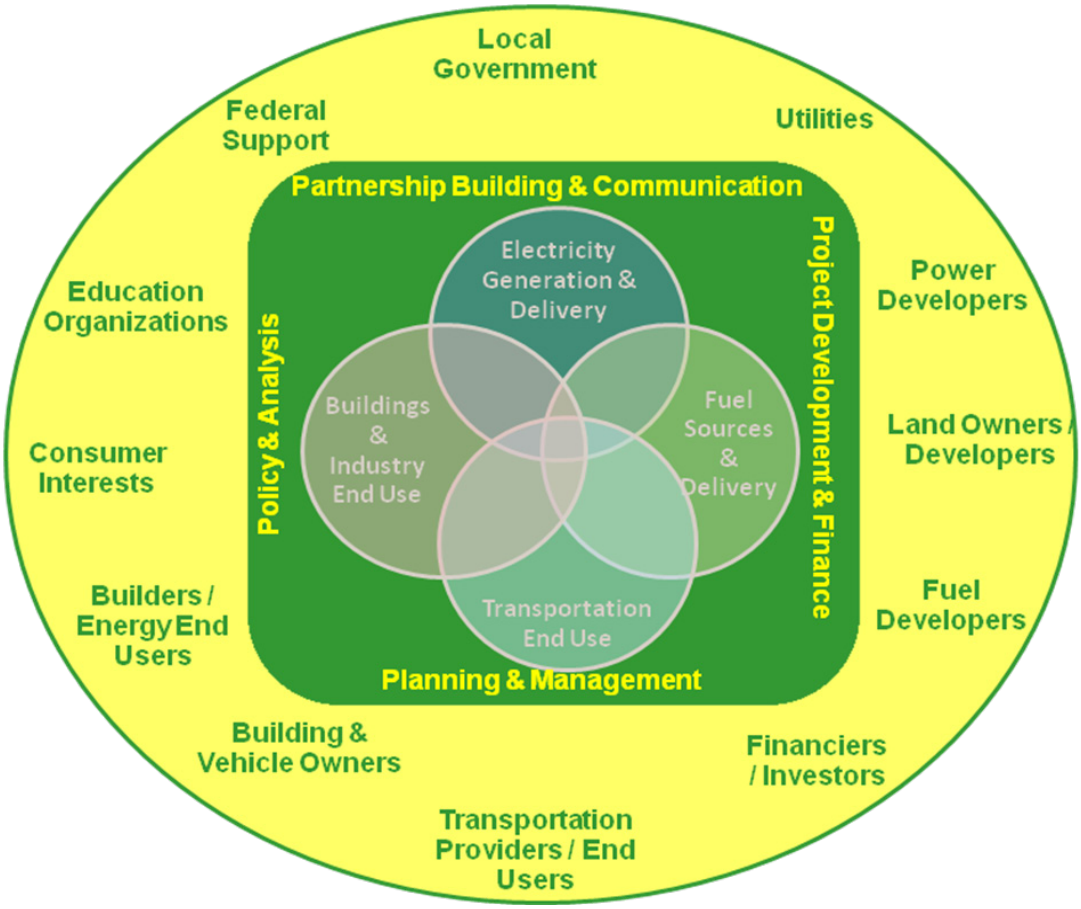


Figure 1. Integrated Deployment model

As NREL has refined the Integrated Deployment model, a common strategy has become evident that allows for a holistic approach resulting in transformation of the energy system and energy usage. Figure 2 depicts the strategy applied to Integrated Deployment projects and the key elements of each strategy.



Figure 2. Integrated Deployment strategy

Achieving a transformational change to an energy system takes multiple steps across multiple years. Figure 3 shows the phases and life cycle of a typical Integrated Deployment project.

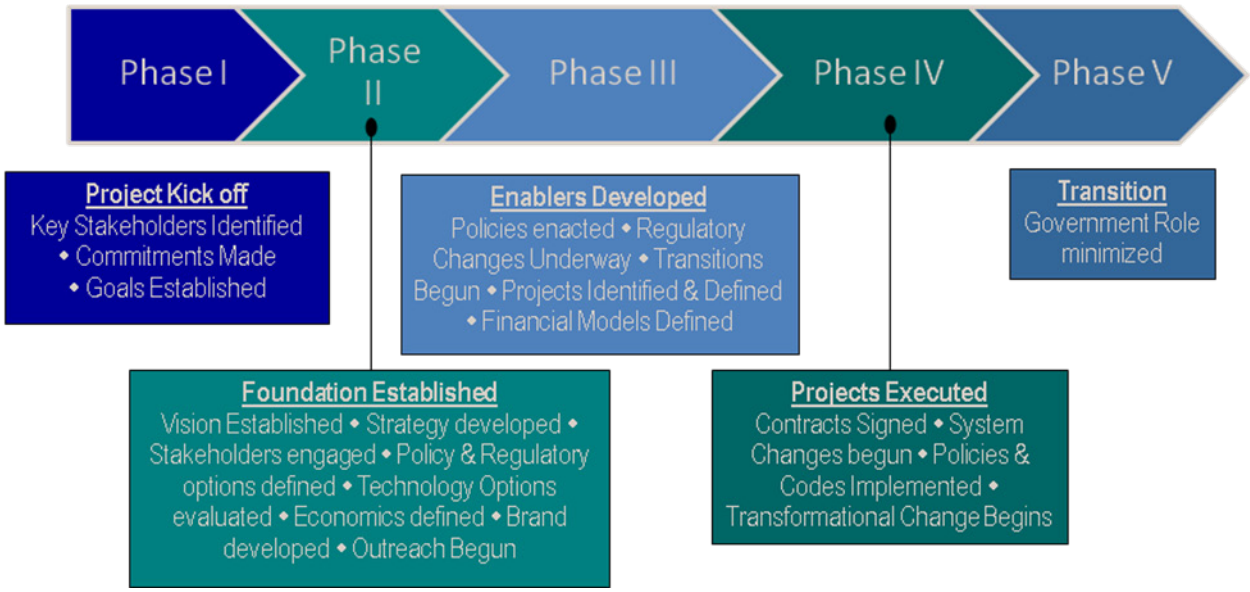


Figure 3. Integrated Deployment project life cycle

While each phase has a primary focus, elements of each phase may take place at any time throughout the project. For example, "early wins" are an important part of the foundation phase (Phase II) of the project, but are not the primary focus of that phase. Policy and regulatory options may be introduced throughout the project as support builds and stakeholder thinking evolves.

Within each project, tasks are broken down into four categories that vary in level of effort throughout the project life cycle. Figure 4 shows the relative level of effort across each category by project phase.

Relative Resources by Work Breakdown by Project Phase

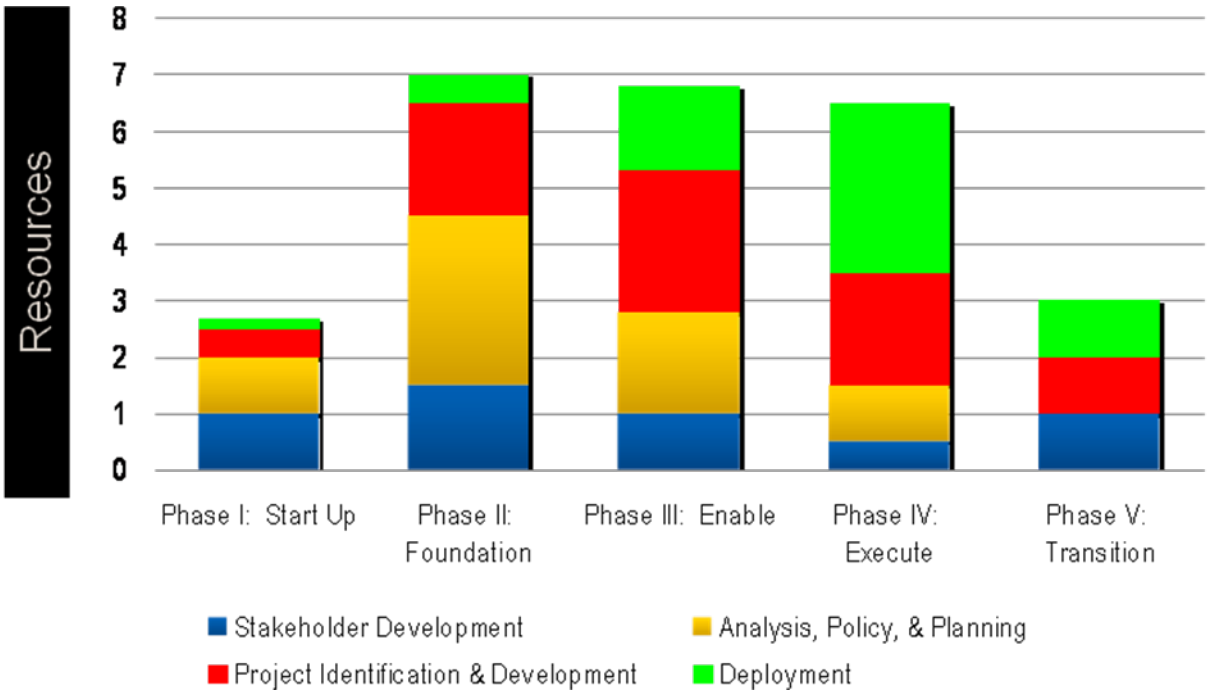


Figure 4. Integrated Deployment project resources

Implementation

To date, several Integrated Deployment projects have taken place at the community and city level, the federal agency level, the state level, and the national level. Each project started due to a unique opportunity (concentrated rebuilding in New Orleans, 100% green rebuilding goal in Greensburg, Kansas); adverse economic circumstances ($.50/kilowatt hour (kWh) electricity rates in Hawaii, $1.00/kWh in Alaskan villages); or mission-related concerns (energy security and reliability issues for the U.S. Department of Defense (DOD), pollution impacts for National Security Foundation Polar Research). These projects represent a sampling of different locations, circumstances, and issues, but all reflect examples of successful implementation of the Integrated Deployment model that can be replicated across the country and globe. Figure 5 shows the locations of each project to date, while Table 1 lists each Integrated Deployment project with a description, status, and results to date.

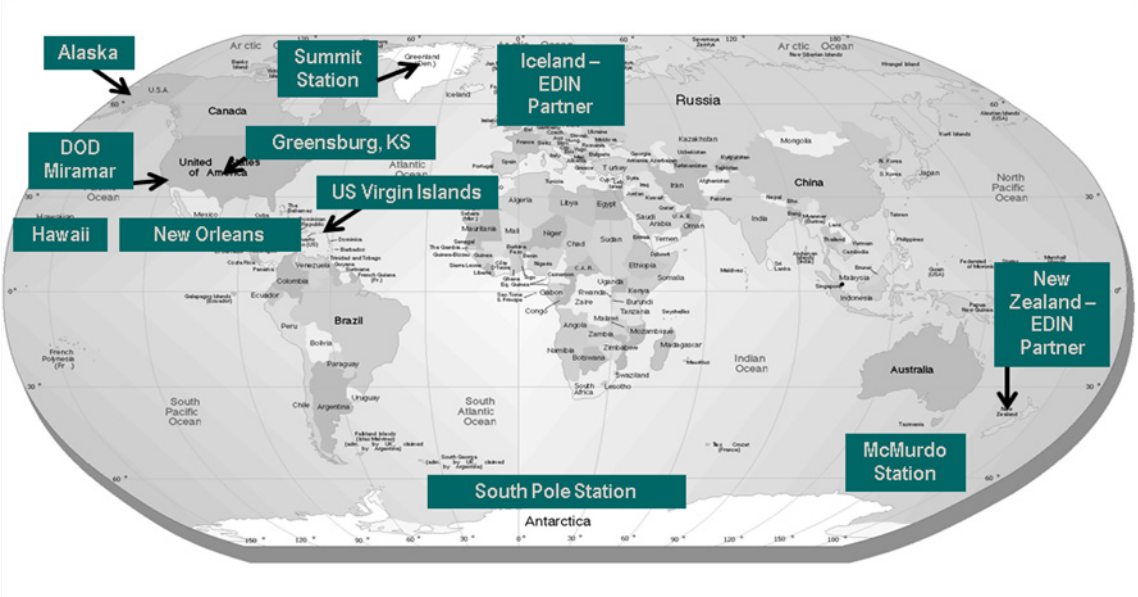


Figure 5. Integrated Deployment project locations to date

Table 1. Integrated Deployment Projects to Date

	Location	Scope / Goal	Start / Status	Results
Community / City	• New Orleans	Rebuild efficiently, Energy policy	2007 Phase V	• All new schools 30%+ better than code • Highest % of Builder's Challenge homes (30% better than code) per capita in U.S.
	• Greensburg	100% renewable energy / LEED Platinum buildings	2007 Phase V	• 100% renewable energy (wind) • Average 37% more-efficient homes • LEED Platinum hospital, school, city buildings • Highest # LEED buildings per capita in the world
	• Community renewable energy grants	All EERE tech	2009 Phase I	• ARRA funded; grants awarded 2010 • Projects just starting
Federal Agency	• DOD	Net-zero energy military base	2008 Phase II-IV	• First base for implementation of net- zero plan (Miramar) • 2 additional base plans under development
	• National Science Foundation	Clean energy polar regions	2008 Phase III	• Wind systems at Summit and McMurdo • Sustainable base redesign for Summit Station • High-efficiency housing designs for South Pole • Electric light duty, snow machines, and 4x4 testing at Summit and South Pole
State	• Hawaii	70% clean energy	2008 Phase III	• 40% renewables portfolio standard (RPS) / 30% energy efficiency portfolio standard (EEPS) by 2030 passed in 2009 • 400 MW of wind through undersea cables under development • Electric vehicle ready grant and rebate program established • 50% RPS, 15% EEPS by 2025 proposed
	• Alaska	All EERE tech	2009 Phase II	• Report on EERE opportunities and challenges
National	• Energy Development in Island Nations (EDIN)	Transform island energy systems	2009 Ongoing	• International partnership established in 2008 with Iceland and New Zealand • Assessing geothermal on Dominica and in South Pacific, and clean energy transformation in U.S. Virgin Islands
	• U.S. Virgin Islands	60% clean energy	2009 Phase II	• Project kickoff in 2009; 60% clean energy goal established by Governor • Foundational development establishing partners and business case across energy portfolio

NREL has found that an organizational framework is extremely useful for local partners to create a venue for key stakeholders, industry leaders, and local and U.S. Department of Energy (DOE) experts to agree upon goals and assumptions, develop information, and make joint decisions. These group meetings, often referred to as working groups, strongly support the buy-in process and coordination of the wide range of stakeholders engaged in the project. Figure 6 shows the common components of the organizational framework, essentially mirroring the Integrated Deployment components.

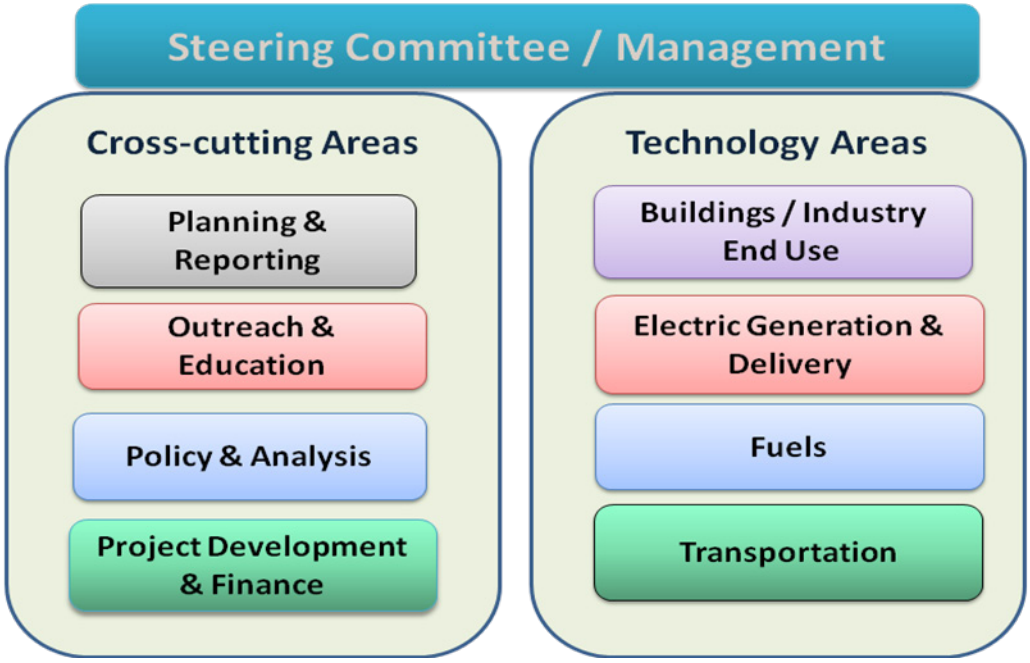


Figure 6. Project organization framework

Integration Across DOE

DOE's Energy Efficiency and Renewable Energy (EERE) programs have many deployment efforts that focus on either technology-specific deployment or market-specific deployment. Table 2 shows these deployment programs and the focus of each.

Table 2. DOE EERE Deployment Programs

Technology-Specific Deployment	Program Focus	Market-Specific Deployment	Program Focus
Wind Powering America	Wind industry development	**Federal Energy Management Program**	Meet federal energy mandates
Solar America Cities	Solar distributed deployment	**Tribal Energy Program**	Support clean energy within Tribal areas
Clean Cities	Local adoption of energy-efficient transport practices	**State Energy Program**	Support state energy programs
Solar Decathlon	Efficient homes with solar	**International**	International energy policy / assistance
Building America	Production Builder Industry EE development		
Weatherization	Energy efficiency in affordable homes		

Each of these deployment programs has a specific mission and purpose. Coordination across the programs and integration between all efforts is needed. With Integrated Deployment projects, NREL integrates and leverages all the deployment programs across EERE and incorporates them into overall project efforts.

While the Integrated Deployment effort initially started as an integration effort across EERE, it quickly grew to include the Office of Electricity Delivery and Energy Reliability (OE) and, more recently, the Office of Fossil Energy (FE). A few examples of cross-cutting work across DOE include:

- For the Hawaii project, significant challenges exist in the transmission and distribution of a high penetration of variable power renewables on isolated grid systems. This challenge piqued the interest of OE, where the project grew to become a partnership between OE and EERE to try to accomplish a 70% clean energy economy by 2030.

- In Alaska, the Arctic Energy Office, an FE-funded DOE office, was asked to expand its mission to include EERE support. This prompted the hiring of NREL staff who focus on EERE support and work in the Arctic Energy Office as part of the DOE team in Alaska.

- Another example of the broadening of Integrated Deployment across DOE is in the DOD initiative to create a net-zero energy military installation, where nuclear energy is identified as a viable option by DOD. As a result, nuclear energy needed to be incorporated into NREL's and DOE's energy analysis calculations to meet DOD's needs.

Collaboration with other federal agencies has been another key to NREL's Integrated Deployment success. Projects have included partnerships with DOD, Department of Interior, Department of Agriculture, the Federal Emergency Management Agency, Environmental Protection Agency, and Department of State.

Transforming the National Energy System

Transforming the entire energy value chain in the United States will require a dedicated effort focused on change through technology, policy, and deployment. DOE has the knowledge and experts across the technologies to solve the problems of our current energy system, but needs a dedicated and integrated effort that focuses on the entire system. This requires experts focused on the application of the technologies, policies, and regulations to enable technologies and serve as drivers; analysis to create informed decisions; economic factors to create market pull; and stakeholder development to create the political will to sustain the efforts.

One of the major hurdles to energy transformation is our instinct to "go with what we know". Utilities make decisions based on their existing knowledge of "tried and true" technologies. Consumers buy based on what they think meets their needs and fits their budget. Financiers make investments based on risk assessments and analysis. To evolve past our current energy system, traditional utilities must learn a new way of doing business; consumers need to expand their knowledge of new technologies to make informed, sustainable choices; and risks need to be reduced for financiers and investors to enthusiastically support clean energy. An energy transformation requires an evolution in how we think about energy.

NREL's experience has shown that no single technology or policy will provide the "silver bullet" that will allow us to meet the nation's clean energy transformation goals. The Integrated Deployment approach draws from the best of technologies and programs to formulate comprehensive and coordinated solutions that are responsive to real world constraints and opportunities.

Using the comprehensive implementation strategy laid out in this document, NREL and DOE can provide integrated and comprehensive energy solutions to utilities, states, and regions across the United States to facilitate informed and optimized decisions around energy production, distribution, and use.

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