Reducing Market Barriers to Small-Scale Distributed Generation in Montana

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1. Introduction

The state of Montana is approaching many decision points as it prepares itself to service the future energy needs of its geographically dispersed population. These decisions include costly investments in the aging rural electricity infrastructure during the next two decades, the structure of residential and commercial tariffs as the state continues down the road of deregulation or re-regulation, and investments in emerging distributed energy technologies that take advantage of our rich and diverse resource base in clean fuels, including natural gas, wind, solar, and biomass.

The primary goal of this project is to reduce regulatory and market barriers that could stifle widespread acquisition and installation of small-scale distributed generation (DG), including fuel cells. Aside from the remaining technical hurdles for these technologies, a significant common barrier to overcome for all small to medium scale distributed energy technologies is the high transaction cost relative to the cost of the technology itself. For these residential and commercial units, the cost of selling, siting, permitting, and servicing distributed generation accounts can quickly make the technologies uneconomic. If these emerging technologies are to penetrate the market, the total transaction cost per unit must be greatly reduced through streamlined business and regulatory processes.

The purpose of this report is to discuss research findings on current market barriers and proposed solutions; a separate report addresses regulatory barriers and potential policies to overcome these barriers. The specific objectives of this project follow closely the Action Plan for Reducing Barriers to Distributed Generation, as defined in the NREL report, “Making Connections: Case Studies of Interconnection Barriers and their Impact on Distributed Power Projects.” The specific objectives that relate to market barriers include the following:

<u>Reducing Business Practice Barriers</u>

1. Define standard business practices for utility review of residential and commercial interconnections with the power and natural gas distribution grids.
2. Define standard business terms for residential and commercial interconnection agreements to facilitate multiple distribution channels for distributed technologies.
3. Develop streamlined business process maps for utilities and distributors for sales and service of residential and commercial distributed generation accounts.

The approach taken in this project was to first document current business practices that are in place by Montana's energy service companies and electrical utilities and rural cooperatives. Utilities, cooperatives, and companies involved in small-scale distributed generation activities were interviewed to document current business processes, resource costs, and standard interconnection and net metering agreements. This interviewing process gave us specific insights into transaction cost and other market barriers associated with selling, installing, and servicing small-scale DG units in Montana. Since a special focus of this project was to research business processes and models for emerging technologies such as fuel cells, we interviewed a facility manager who had just guided an installation of commercial fuel cells and documented our personal experience in managing residential-sized fuel cell demonstration projects.

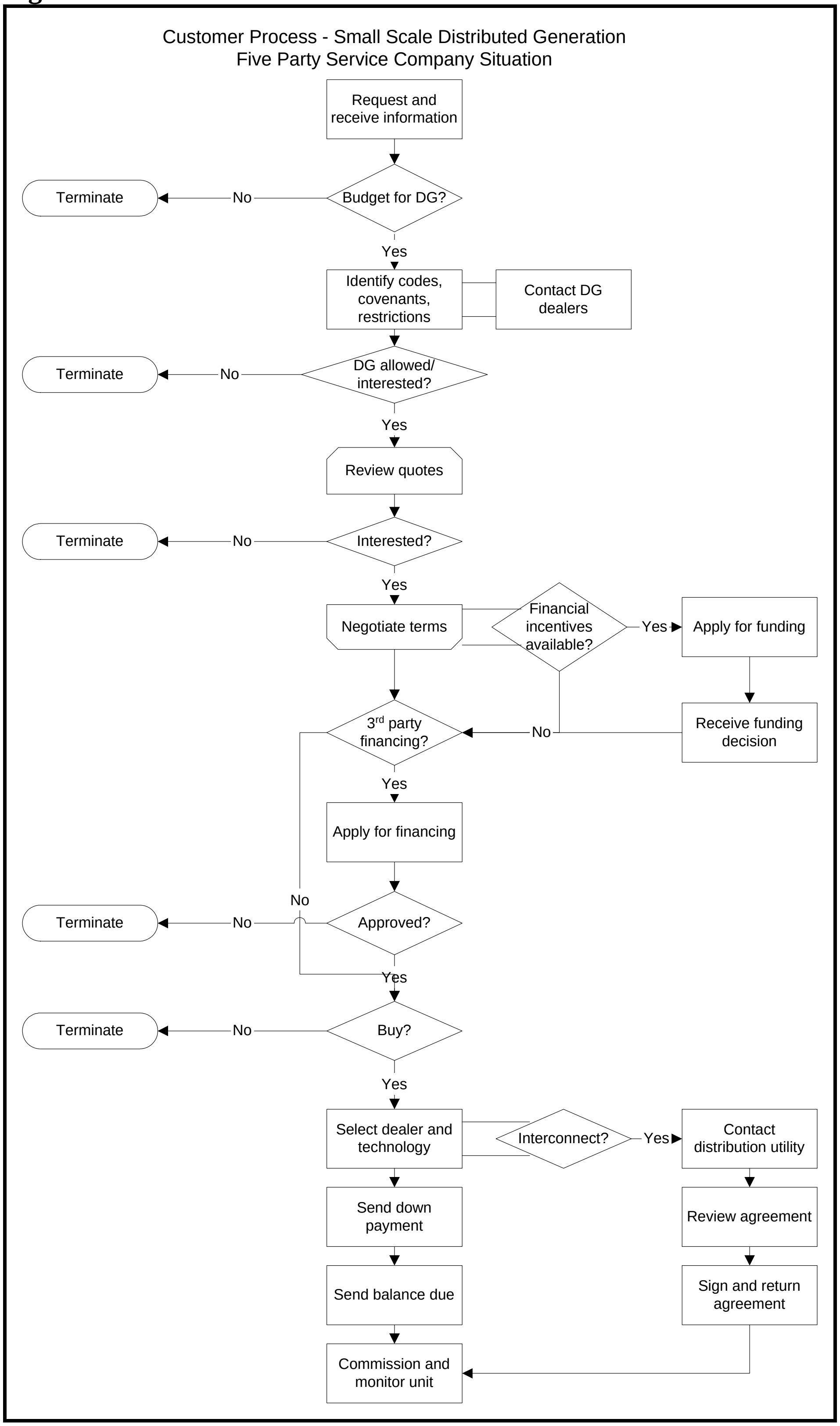
The final step was to develop recommendations for changes to current business processes and standard terms and agreements. Simulations were run to create a set of residential and small-scale DG business processes for energy service companies that keep transaction costs low relative to the cost of the equipment. Section 3 of this report discusses the simulation results and recommended business processes and model for selling, installing, and servicing small-scale DG units.

2. Current Situation

2.1 Customer Perspective

The current process for acquiring distributed generation is typically a five-party transaction from the customer's perspective. Figure 1 shows the customer process for a typical small-scale DG application, either residential or small commercial. In this transaction, the parties include (1) the customer, (2) the dealer or energy service company, (3) the financing company, (4) the local electric distribution utility, and (5) a governmental or non-profit entity that administers incentive programs. The customer deals with these other four parties to acquire, install, finance, and receive subsidies for distributed generation equipment. In Montana and most other states, distributed generation incentive programs that include low-interest loans and grants

Figure 1: Customer Process



require the customer to apply for the incentive by collecting quotes and filling out a form that provides information on their facility. In actuality, the dealer or energy service company helps the customer fill out the details on the application, and often is the channel through which the customer learns of the incentive. The local utility involvement is required for the customer to receive the right to distribute excess power to the grid and receive credit for this power in the case of net metering.

In addition to the multi-party transaction process, other market and regulatory barriers faced by customers include

- *Budget/financing constraint:* According to a recent survey conducted by *Electric Light & Power*, 62 percent of respondents said that initial equipment cost is a barrier to adoption. (June 2003, volume 81.06). In comparison, only 34% said that energy cost ($/kWh) is a barrier. For commercial customers, this budget or financing barrier relates to how the commercial customer chooses to deploy their balance sheet. Distributed generation equipment may not be viewed as a core business investment by the customer, so taking on debt or equity ownership of a non-core asset becomes a barrier to adoption of the DG technology. For residential customers, this budget or financing barrier relates to the household budget constraint. For major appliance and vehicle purchases, customers typically budget on a monthly income basis, with household living expenses, loan payments, discretionary spending, and savings deposits equaling monthly household income. Unlike other major household appliances - like a furnace or air conditioner - DG equipment is viewed as discretionary spending rather than a household living expense. Categorized in this way, the purchasing decision for DG equipment now has to compete with other discretionary purchases that may vary widely from an overseas vacation to a new deck to a big screen TV.
- *Involved technical sale:* Shopping and deciding to purchase DG equipment is perceived as an involved technical sale for the customer, especially since almost all customers have never purchased DG equipment before. The customer must educate themselves on the different technologies, and they cannot turn to trusted sources such as Consumer Reports. The perceived technical nature of the sale works in the favor of do-it-yourself

customers who tend to enjoy educating themselves about new technologies, but is a barrier to widespread adoption. A lower involvement buying process is necessary to break out of the limited do-it-yourself market and have appeal to the broad mass market.

- *Choices limited to high-priced renewable or low-priced polluting engine technologies:* Until recently, customers' choices for small-scale DG have been limited to reciprocating engines, wind turbines, and solar photovoltaic panels. The reciprocating engines have significant air and noise pollution, while the wind and solar technologies are very expensive relative to grid power. This situation is changing, however, with the emergence of microturbines, Stirling engines, and fuel cells for small commercial and residential applications.
- *Interconnecting and net metering may not always benefit customer:* From the customer's perspective, interconnecting the DG equipment with the grid may have fewer benefits and require a significantly more involved transaction process than deciding not to supply excess power that is generated on-site to the grid. This lack of benefits is especially the case for small-scale DG, since the amount of power generated is small relative to the mostly fixed transaction costs. Incentive programs, however, are often tied to an interconnection requirement and thus encourage behavior that the customer may not view as being in their best interest if the incentive program were not in existence. In the *Electric Light & Power* survey cited above, 31% of respondents said that grid interconnection is a barrier to adoption of DG equipment.

2.2 Energy Service Company / DG Dealer Perspective

For small-scale applications of DG, the customer is usually the driving force for acquisition and installation since most DG dealers and energy service companies focus on large-scale projects. For small net metered interconnections, the homeowner may decide to do the installation themselves with the help of a licensed electrician, while larger applications almost always involve an engineering firm, dealer, and contractors to perform the installation. Often the engineering firm takes the lead working with dealers to sell DG devices. More recently, unregulated energy firms are becoming owner-operators of DG equipment at customer sites, acting as an on-site utility that charges the customer for the cost of electricity used at the site (and for thermal energy, if a combined heat and power application) rather than charging for the equipment and installation.

Residential DG Distributor Business Processes

Figure 2 shows a typical process map for distributed generation dealers selling to residential consumers. The typical process is to generate leads through various media, follow-up on leads to qualify prospects and gather information, prepare a sales agreement based on appropriate technology design for the site, and then install the equipment. Typical resource costs for the process of generating a lead to installing the system is $1,000 to $2,000, depending on the installation costs for a particular residential design.

To obtain the typical resource cost per residential customer that installs distributed generation, the drop-out rate for customers must be factored into the equation. That is, resources are expended by companies to market to a prospect, only to have the prospect never purchase DG equipment. Based on our experience and sample of companies, around 80-90% of prospects who initially request information on distributed generation from a company drop out of the process before purchasing the equipment. With a cost of $100 to prepare a sales agreement, the typical resource cost per distributed generation customer increases by about $800 due to this high drop-out rate.

Commercial and Industrial DG Distributor Business Processes

The business process is a bit more complex for commercial or industrial sized DG in the range of 50kW to 250 kW, since significantly more engineering analysis must be performed to understand the load profile at the site and to develop schematics for installing and connecting the DG equipment to the site's end-use loads and the grid. Figure 3 shows a process map that is typical for distributed generation dealers and energy service companies selling to commercial and industrial customers. The initial proposal to the customer defines the project to be considered. If the customer agrees with the project, engineering design and DG equipment are specified to develop a price proposal for the project. Once the customer agrees to the proposal, equipment is ordered and installation is scheduled. In the case of the energy service company serving as an on-site utility that supplies energy, the company finalizes financing of the equipment at this time. Installation then proceeds and the customer is billed monthly if the

Figure 2: Distributed Generation Dealer Process - Residential

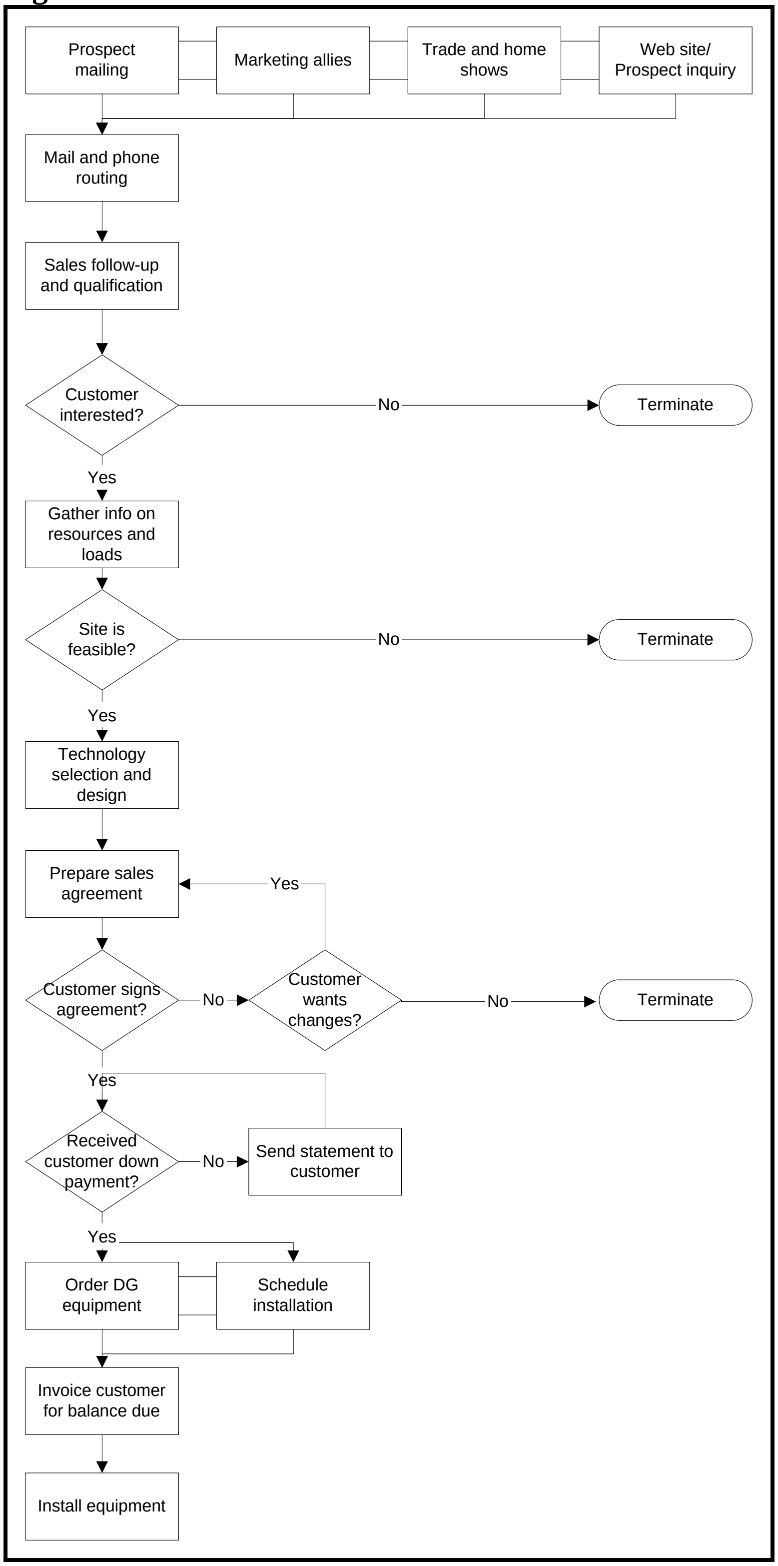
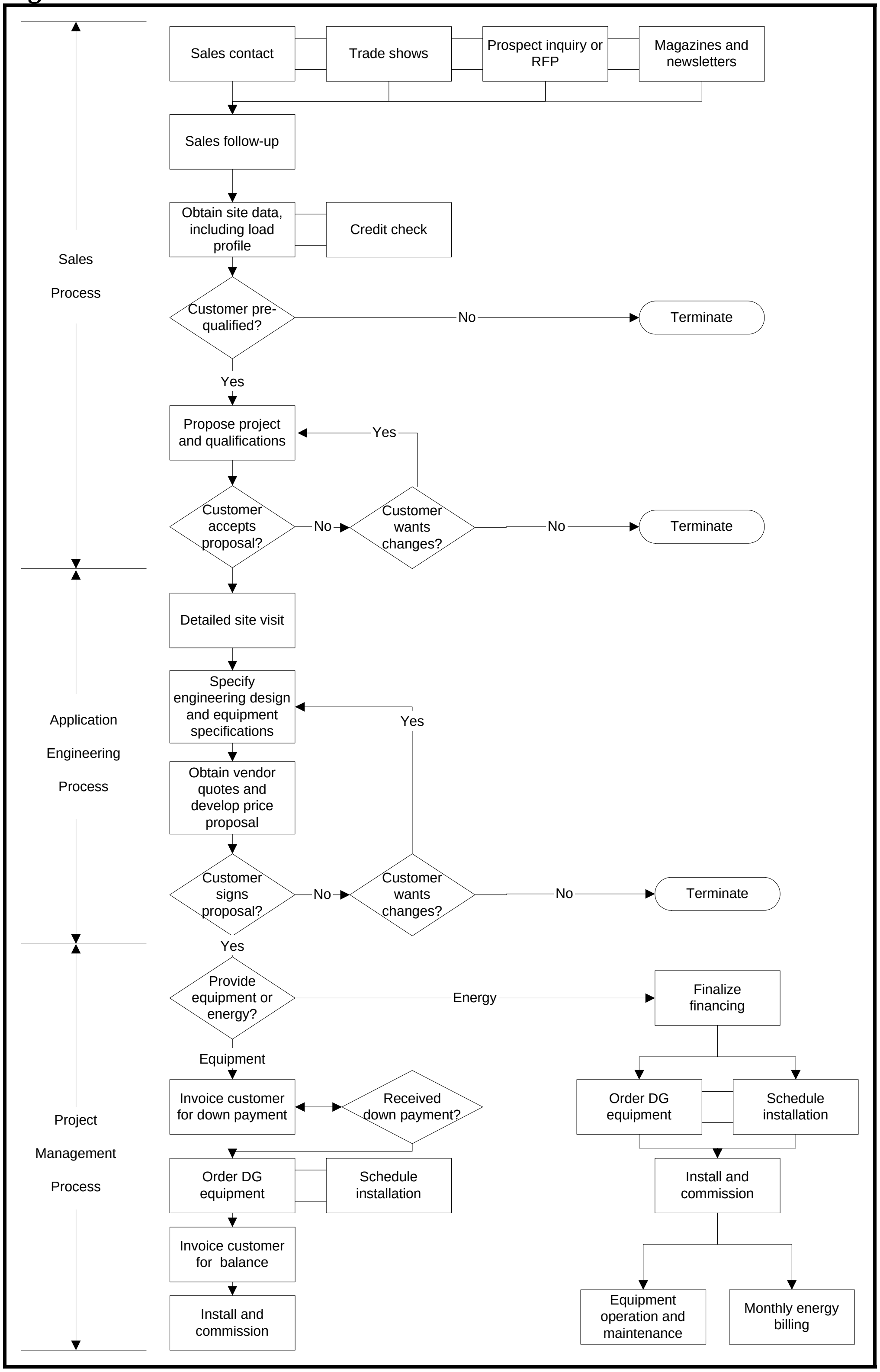


Figure 3: Distributed Generation Dealer Process – Small Commercial



company is supplying energy; otherwise, the project ends for the energy service company after commissioning of the unit.

Resource costs for the initial project proposal are approximately $2,000. The costs for the engineering design, installation, and equipment typically falls in the range of $1,500 to $2,000 per kW, depending upon the type of equipment specified, the size of the equipment, and the complexity of the installation. In the case of the energy service company supplying energy, on-going maintenance and operations costs as well as monthly customer billing costs are typically around ½ cents per kWh. The drop-out rate after the first contact is high for this category of DG customers as well, but these costs are relatively low compared to the costs of engineering design and installation. It appears that this initial proposal step to pre-qualify customers is very important to keep the cost per sale down. Once customers advance past this stage, most customers continue through installation unless economic conditions constrain their ability to finance the deal.

Dealers mentioned several barriers during the course of the interviews. These barriers include:

- *Batch, manual production runs*: Manufacturers of DG equipment, especially renewable energy devices, manufacture the equipment in batch runs. This process lengthens delivery times for dealers and increases the cost of equipment over automated processes. Getting delivery on generation equipment and inverters in timely manner is a headache for dealers in scheduling installations and keeping customers happy.
- *Financing*: Equipment manufacturers require partial payment at the time equipment is ordered, with the balance due before delivery. The dealer is forced to pass these financing terms along to the customer. With long lead times for delivery of equipment, these terms turn off customers.
- *Assistance programs to customers*: One dealer mentioned that assistance programs in the state lead to procrastination among customers in closing a sale. Often times the dealer ends up doing all of the work to apply for the assistance and then is dependent upon the prospect to send in the application materials. Additionally, the prospect may wait to buy

if the grant is not awarded during the current funding cycle, thinking they will be awarded a grant during the next cycle.

Fuel Cell Acquisition, Installation, and Servicing/Monitoring Processes

An area of special focus for this project is on business processes for emerging technologies, specifically fuel cells. Stationary fuel cell distributed generation units are still in the product development stage, but far enough down this path so that field demonstrations are being implemented for both combined heat and power and electric power applications only. For the purpose of this project we are most concerned with barriers for product applications that will be first-to-market.

The business process maps for site feasibility and design (including identifying code and infrastructure restrictions), site preparation and installation, and monitoring, outage service, and preventive maintenance are shown on Figure 4-7. These diagrams show the process flowcharts for the fuel cell demonstrations mentioned above.

When compared to the processes for other small-scale distributed generation units that are currently available today - such as microturbines or diesel gensets - there are very few peculiarities associated with the design and build processes for fuel cell distributed generation applications. The only peculiarities identified during the demonstration phase of market introduction include more close involvement by the fire marshal during the permitting process, plenty of hands-on assistance from manufacturers, and preventive maintenance schedules that are not yet well-defined. Given that few differences exist during the demonstration phase, we expect that the details of the code investigation, site feasibility, installation, and monitoring and servicing processes diagrammed in this brief will mirror those of products commercially available today once fuel cells are introduced to the market.

The main difference, as with all new technologies that are introduced in the market, is that fuel cell installations require much more work on the part of the project team to educate themselves, subcontractors, and city and county officials. For example, at the demonstration stage the fire marshal, water quality, and other senior regulatory personnel want to be personally involved in the permitting process since the technology is unknown to them. Once their departments routinely handle permits for fuel cell applications, we expect the permit and

Figure 4: Fuel Cell Site Location Process

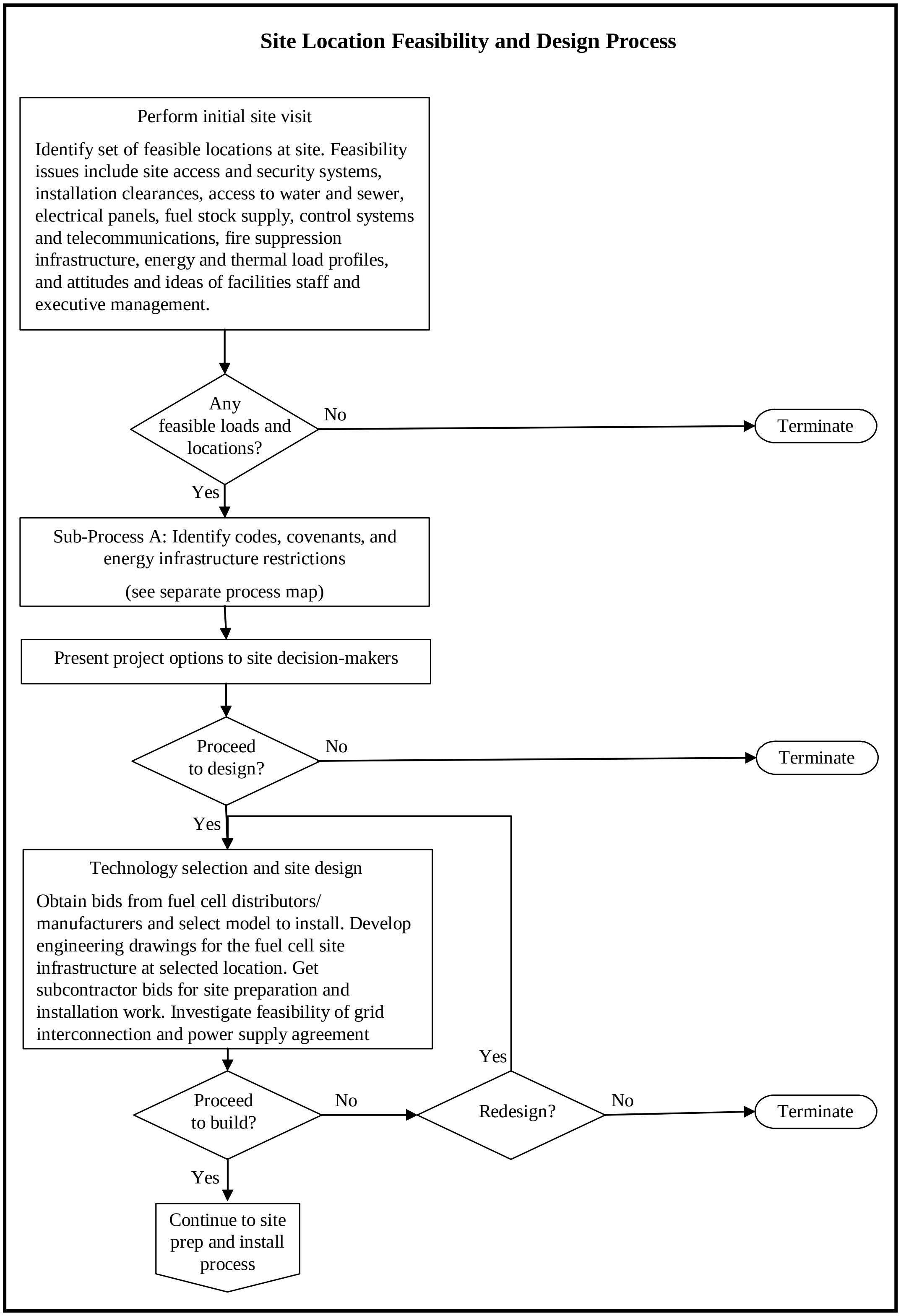


Figure 5: Fuel Cell Codes, Restrictions Process

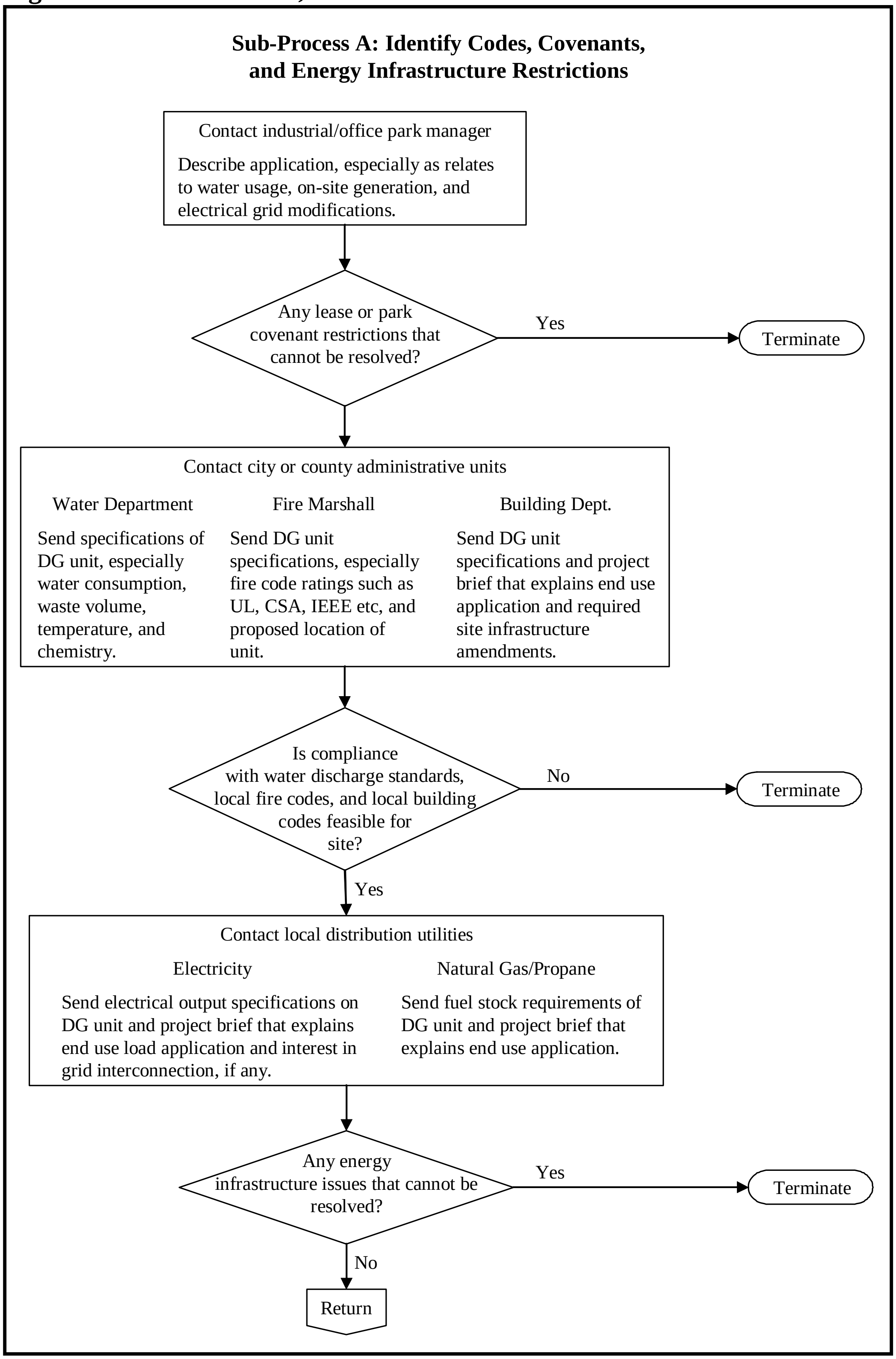


Figure 6: Fuel Cell Site Preparation and Installation Process

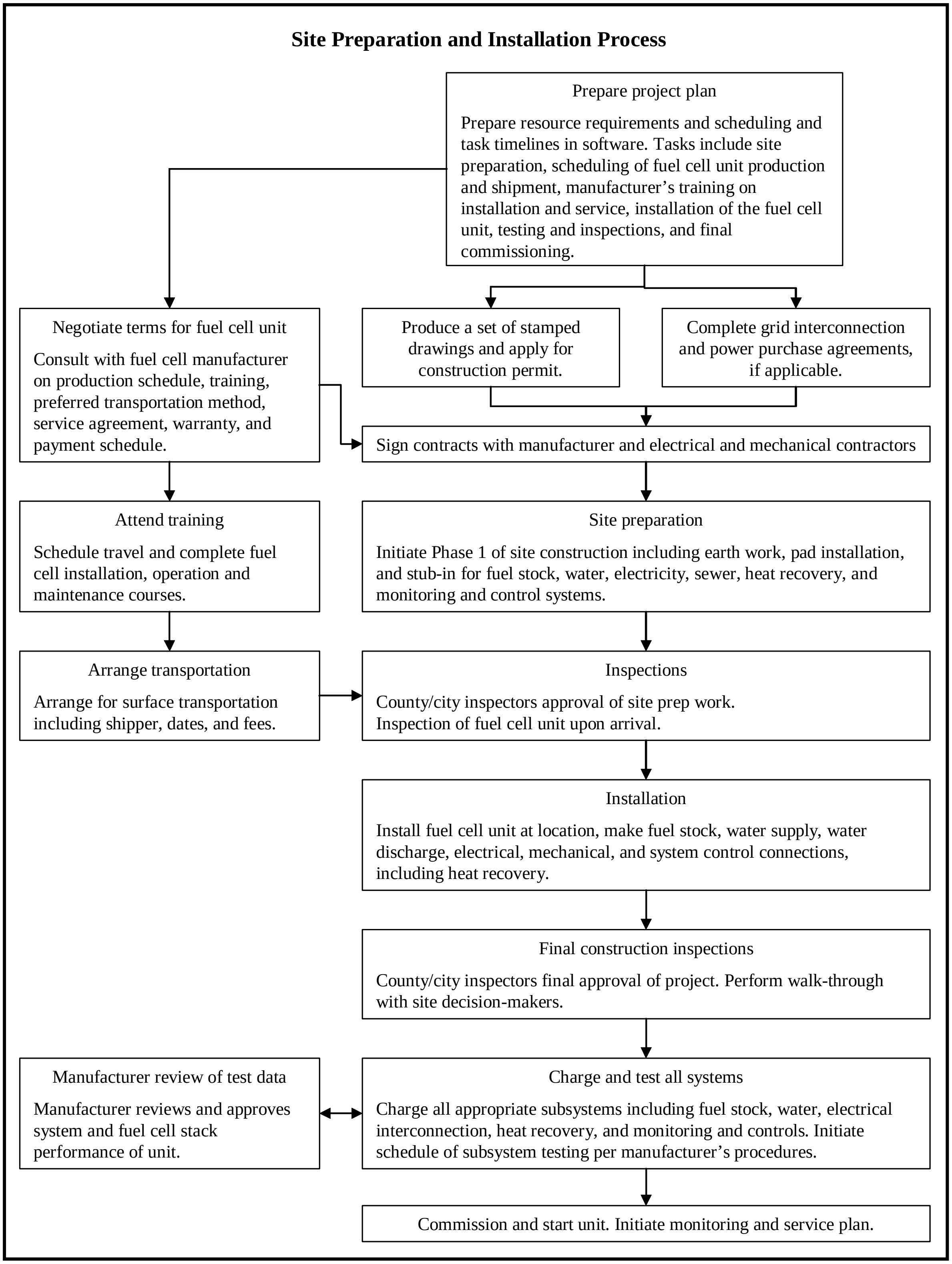
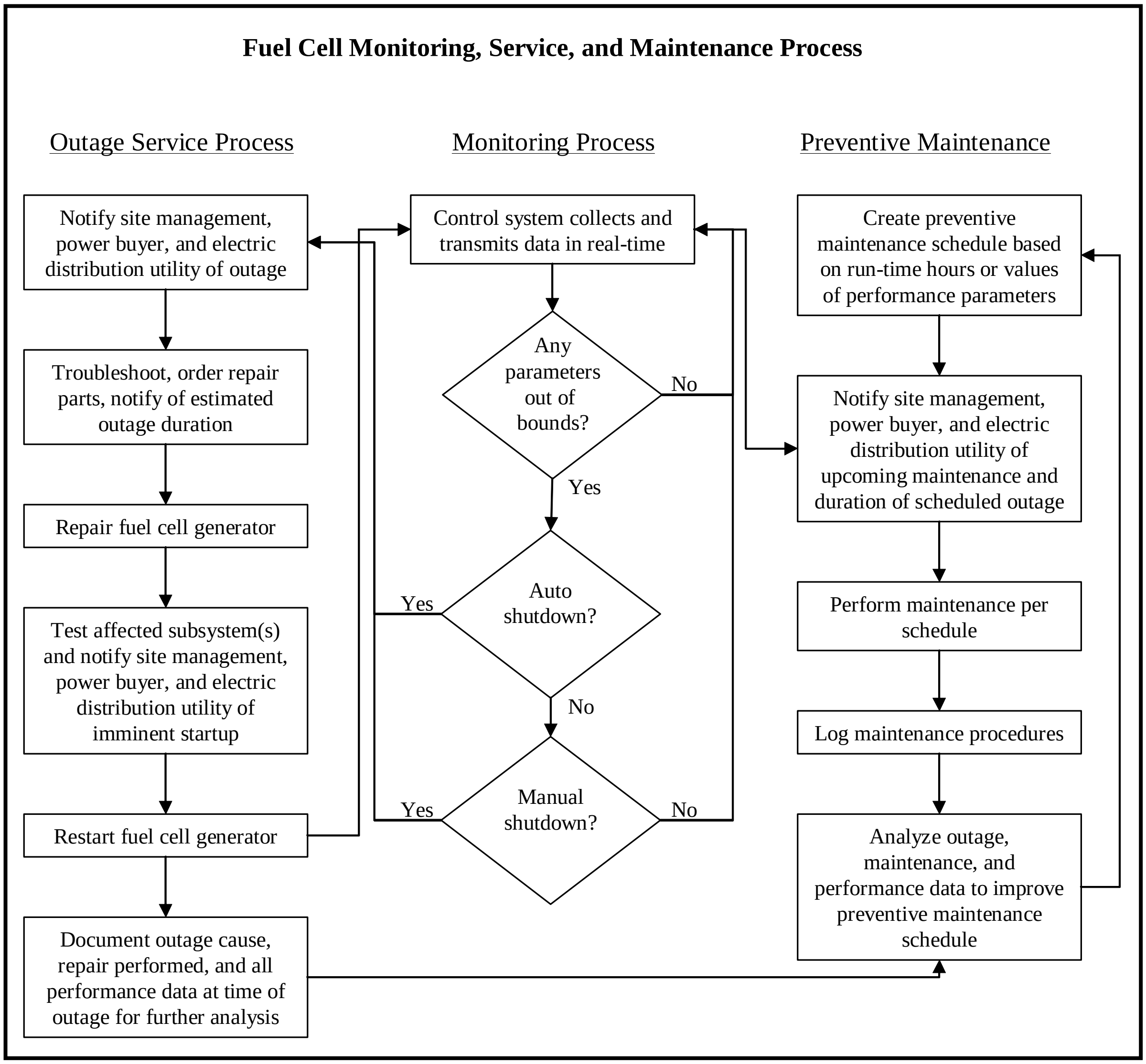


Figure 7: Fuel Cell Monitoring, Maintenance, and Outage Service Process



inspection process for fuel cells to become routine procedures handled at the appropriate staff levels, which should speed up the permitting and inspection processes.

2.3 Utility Perspective

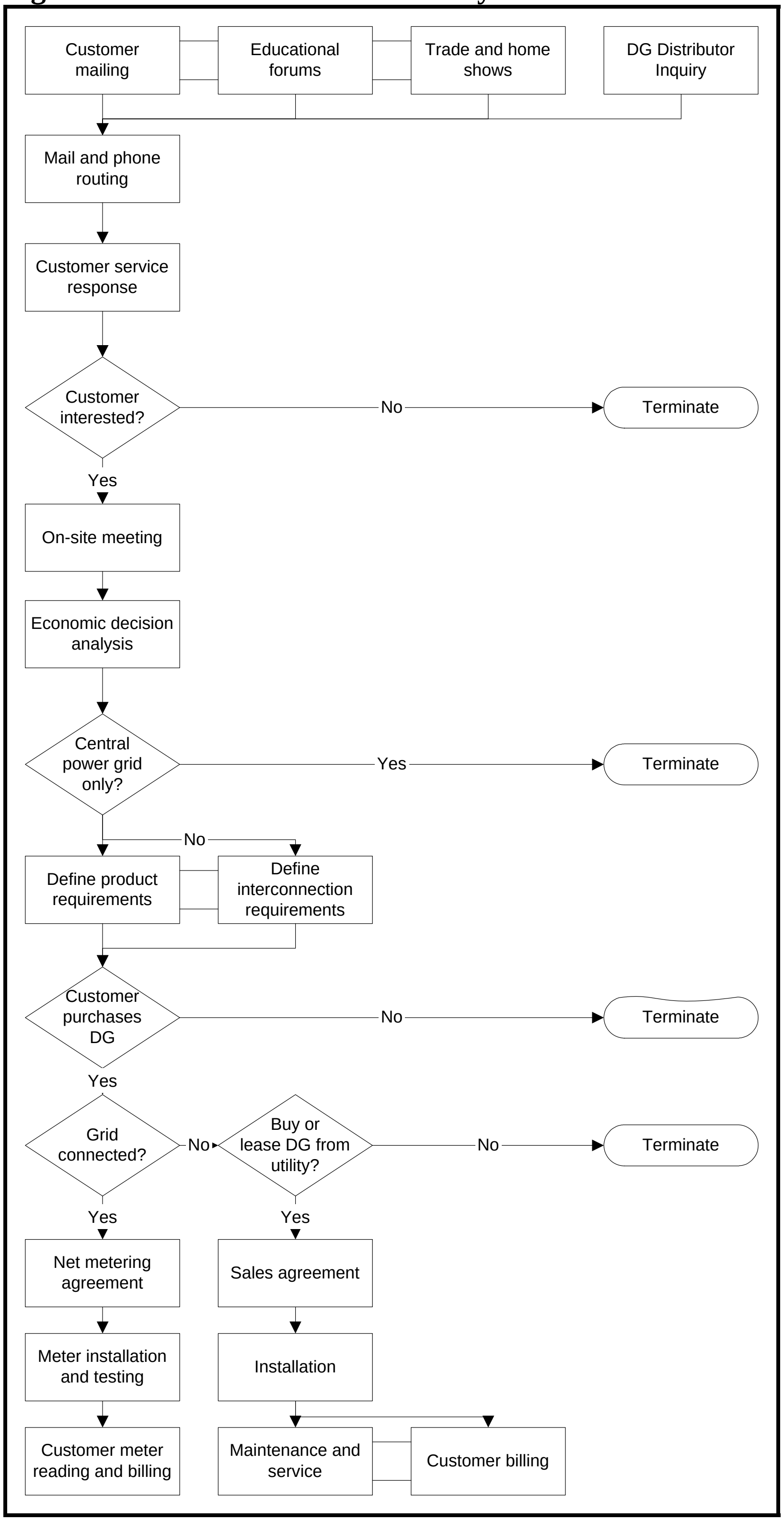
In general terms, most utilities and cooperatives described their process as (1) responding to customer requests for information, (2) testing interconnection and commissioning the device, and (3) meter reading and billing. Some of the utilities and cooperatives had developed supporting materials to send to customers in response to requests for information, while others relied on phone conversations and site visits to respond to requests. All cooperatives and utilities had standard interconnection, net metering, and supply agreements in place as well as safety requirements for interconnecting with the grid. The automated meter reading technology deployed at cooperatives around the state does not facilitate net meter reading unless an additional meter is installed, so the meter reading process is either done manually for net metered customers or an additional meter is installed as part of the interconnection process. If two meters are used, the billing calculation must be done manually, since the reading from one meter must be subtracted from the other meter to obtain one customer bill.

The breakpoint for interconnecting to the grid via a net metering versus supply agreement is 10 kW for cooperatives and 50 kW for the Northwestern Energy system. With net metering, no engineering studies need to be performed for distribution system and interconnection and transmission system and interconnection, nor does the DG operator have to negotiate supply agreements with a buyer or wheeling agreements with a transmission operator.

Utility business process for distributed generation customers with net metering agreements

Figure 8 shows a typical process map for utilities and cooperatives in Montana for net metered customers. The biggest difference in process across utilities and cooperatives is the on-site visit. A few cooperatives are willing to perform this service for their members, while others are not. Resource costs for the process of taking one customer from initial information request to interconnection and testing range from $100 to $650, depending on the extent of customer education activities, including an on-site visit, and whether a new meter is installed. These costs exclude expenses incurred by the customer on their side of the meter. On-going annual customer

Figure 8: Electric Distribution Utility Process for Net Metered Customers



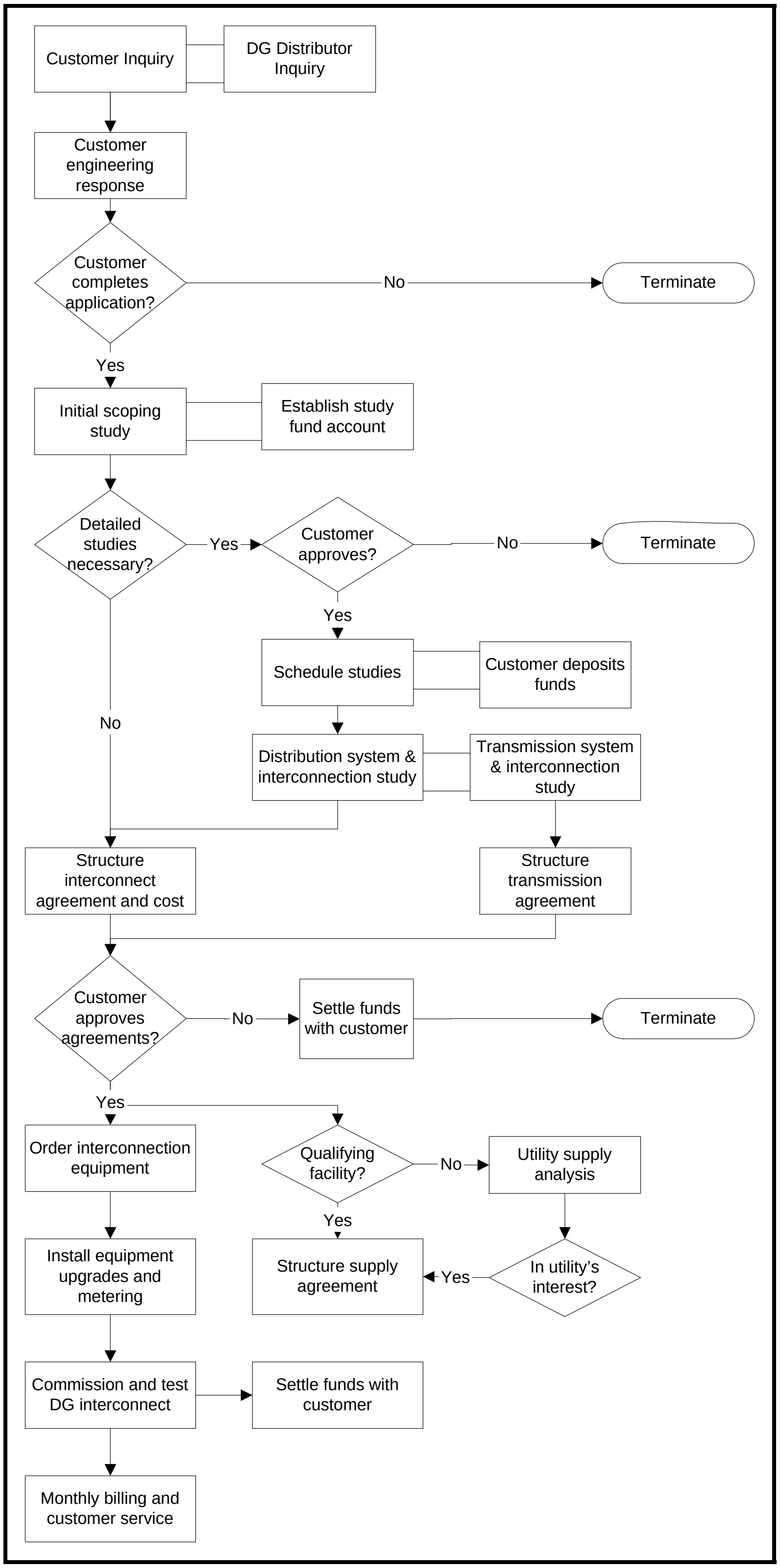
service costs that are over and above the standard service ranged from $0 to over $500, depending on whether manual or automated meter reading and billings processes are used. Zero additional costs for meter reading and billing are incurred when the customer reads the meter, while the $500 cost is incurred in the case where the meter needs to be read manually each month by a technician in place of automated reading and billing.

To obtain the typical resource cost per customer that installs and interconnects distributed generation through a net metering agreement, the drop-out rate for customers must be factored into the equation. That is, resources are expended by utilities and cooperatives in educating customers and responding to specific requests, only to have the customer never purchase DG equipment or if they do, abandon the process of connecting to the grid. Based on our sample of cooperatives and utilities, around 90% of customers who initially request information on distributed generation from their utility or cooperative drop out of the process before purchasing the equipment. With this high drop-out rate, the typical cost per net metered distributed generation customer ranges from $530 to over $1,000.

Utility business process for distributed generation customers with supply agreements

The business process is a bit more complex for interconnected small-scale DG that is not net metered. Figure 9 shows a process map that is typical for utilities and cooperatives for customers that have supply agreements. The initial engineering study determines the extent of analysis that must be conducted to interconnect with the grid. If the DG electricity put on the grid is a significant share of supply within a distribution substation, then more expensive distribution system analysis must be performed. In the case where the DG output is likely to flow to the transmission grid, or if the supply agreement requires wheeling the electricity across the transmission grid, then transmission system and interconnection studies must also be performed. Once the engineering requirements are met, the utility and the DG operator will jointly draft an interconnection agreement and a supply agreement if it is in the utility's interest; otherwise the DG operator negotiates a supply agreement with a third party independent of any utility involvement. None of the cooperatives in the state participate in supply agreements with DG operators in the distribution service territory.

Figure 9: Electric Utility Process for Supply Agreement Customers



Resource costs for the process of taking one customer from initial information request to interconnection and testing ranged from $2,000 to nearly $40,000, depending on the complexity of the distribution situation at the point of installation. There were no on-going customer service costs for the utilities that were over and above the standard service due to the requirement to install all of the necessary metering equipment. While the drop-out rate after the first contact is high for this category of DG customers as well, this rate has very little effect on the utility's cost per interconnected customer since the initial consultation is such a small percentage of the total cost.

In all cases, the engineering costs as well as any system upgrade and metering equipment costs are borne by the DG operator, not the utility. The DG operator is usually required to establish an account upon which the utility can draw funds from to perform their required analysis. This account is in addition to the engineering work required on the customer side of the meter. The DG operator can save considerable money if the DG manufacturer or distributor includes schematics and other engineering specifications as part of the purchase of the device.

Electric utilities and cooperatives mentioned several barriers during the course of the interviews. These barriers include the following:

- *Tariff design is not neutral regarding distributed generation*: Distributed generation equipment reduces the amount of electricity distributed over the grid. In Montana, the utility's return on investment, which is earned from the distribution tariff, is dependent on the quantity of electricity distributed to homes and businesses. So the electric distribution company has a disincentive to promote adoption of distributed generation equipment, since DG reduces the quantity of electricity distributed across the grid. This barrier and the recommended solution is further discussed in the complementary regulatory barriers report.
- *Additional investment in supporting infrastructure is necessary*: Two-way flow of electricity on the grid from the substation to the transformer to the meter and back often requires upgrades to the distribution equipment. The cost of these upgrades can be high for the customer relative to the benefits of selling power back to the system.

- *Widespread adoption will cause problems on small substation grids*: Especially for the rural electric cooperatives in the state, widespread adoption of small, interconnected, net metered distributed generation equipment may exceed the capacities of substation grids to handle the excess power. This problem is more likely to occur for solar and wind technologies, since generation does not necessarily coincide with end-use demand.
- *Small-scale DG is not economic relative to hydro, coal, and large wind farms*: The electric power produced by small-scale DG equipment is higher priced than centralized coal, hydro, and wind generation. Customers are best served, in the view of customer-owned electric cooperatives, by keeping prices as low as possible. So some cooperatives question why government programs offer incentives for small-scale distributed generation rather than centralized generation.

3. Market Barriers and Recommended Solutions

Table 1 lists a summary of important market barriers that we identified along with our recommended solutions. We found that the three biggest areas for reducing transaction costs associated with small-scale distributed generation (DG) products are (1) reducing the number of parties to the customer in the transaction, (2) improving the marketing process and closing rate to reduce cost per sale, and 3) not exporting electric power to the utility grid. Other market barriers included subdivision and zoning restrictions and the high initial capital cost for the equipment. Our recommended solutions include changing the business process so that the consumer is dealing with just one entity during the transaction, developing marketing programs that emphasize a lifestyle message targeted to the True-Blue Greens and Green-Back Greens consumer segments, and moving away from the emphasis on grid interconnection and net metering for small-scale DG towards an emphasis on direct load serving applications.

Table 1: Summary of Important Market Barriers

Market barriers to penetration of technologies	**Proposed solutions**
o Five-party transaction for customer	o Change business process to two-party transaction between customer and DG company
o Closing rate is very low for industry	o Better target marketing, change message, educate consumers through allies
o Interconnection economics are unfavorable	o Do not require interconnection for

Market barriers to penetration of technologies	Proposed solutions
	incentive programs; promote plug-n-play codes for direct serve loads
o High initial capital cost	o Size for direct serve loads, develop ally financing and leasing programs, develop plug-n-play building codes
o Subdivision and code restrictions	o Developer and planner education on advantages of emerging technologies

3.1 Two-Party Transaction Process

The customer must deal with four other parties to complete a distributed generation project. This five-party transaction slows down the sales process and increases the perceived cost and complexity of the deal to the customer. Going from five parties to two – the customer and the energy service company or distributed generation dealer – simplifies the process for the customer, shortens the sales cycle, and reduces the cost of the transaction.

The two-party transaction process for the customer is shown in Figure 10. The corresponding business process for the energy service company is shown in Figure 11. This business process is identical to the current process except that the government incentive and finance providers deal directly with the service company/dealer rather than with the customer. Also, these processes remove the electric distribution utility or cooperative from the transaction by switching to one-way grid installation in which electricity is never exported to the grid.

1. <u>Cash incentive programs flow through energy service company to customer</u>. The energy service company or distributed generation dealer is the natural market ally for marketing government promotional programs that encourage adoption of clean and renewable energy technologies. In the recommended two-party transaction process, the government incentives flow through the energy service company to the customer rather than requiring each customer to file a separate application. This change

   - simplifies the process for administering the program for the government, since the number of people to educate on the details of the program is reduced from each customer to a much fewer number of energy service companies. The process for working with each company can be automated, with automatic approval of site installations that meet standard criteria and electronic submission, review, and approval of non-standard installations;

- simplifies the process for the customer, since they do not need to be educated on the program, fill out a paper application, and coordinate the process with potential dealers; and
- speeds up the sales process for the energy service company, since they can simply offer the incentive as a one-line deduction on their quote, and do so on-site if the installation meets standard criteria.

2. Equipment financing is offered through energy service company or dealer. In this two-party transaction process, third-party financing is offered through the energy service company or dealer channel to the customer. The financing is offered as part of the on-site quote, contingent upon financing company approval which is checked upon uploading information at the office. This process simplifies the buying decision for the customer and automates the credit process through electronic transmissions between the energy service company and the equipment distributor/manufacturer.
3. Electrical distribution utilities and rural cooperatives have minimal involvement in one-way grid installations. Unlike grid parallel installations where electric power is allowed to flow back onto the grid, the one-way grid connection does not require any utility upgrade in meters or distribution infrastructure. Instead, under this recommended process the utility has a list of approved equipment for isolating electricity generated on-site from the grid and performs a simple inspection at the time of installation to insure compliance with standards. In a one-way grid installation, the utility is not involved in netting out the power put back on the grid or in providing distribution and transmission studies and upgrades for power supply agreements.

Figure 10: Two-Party Customer Process

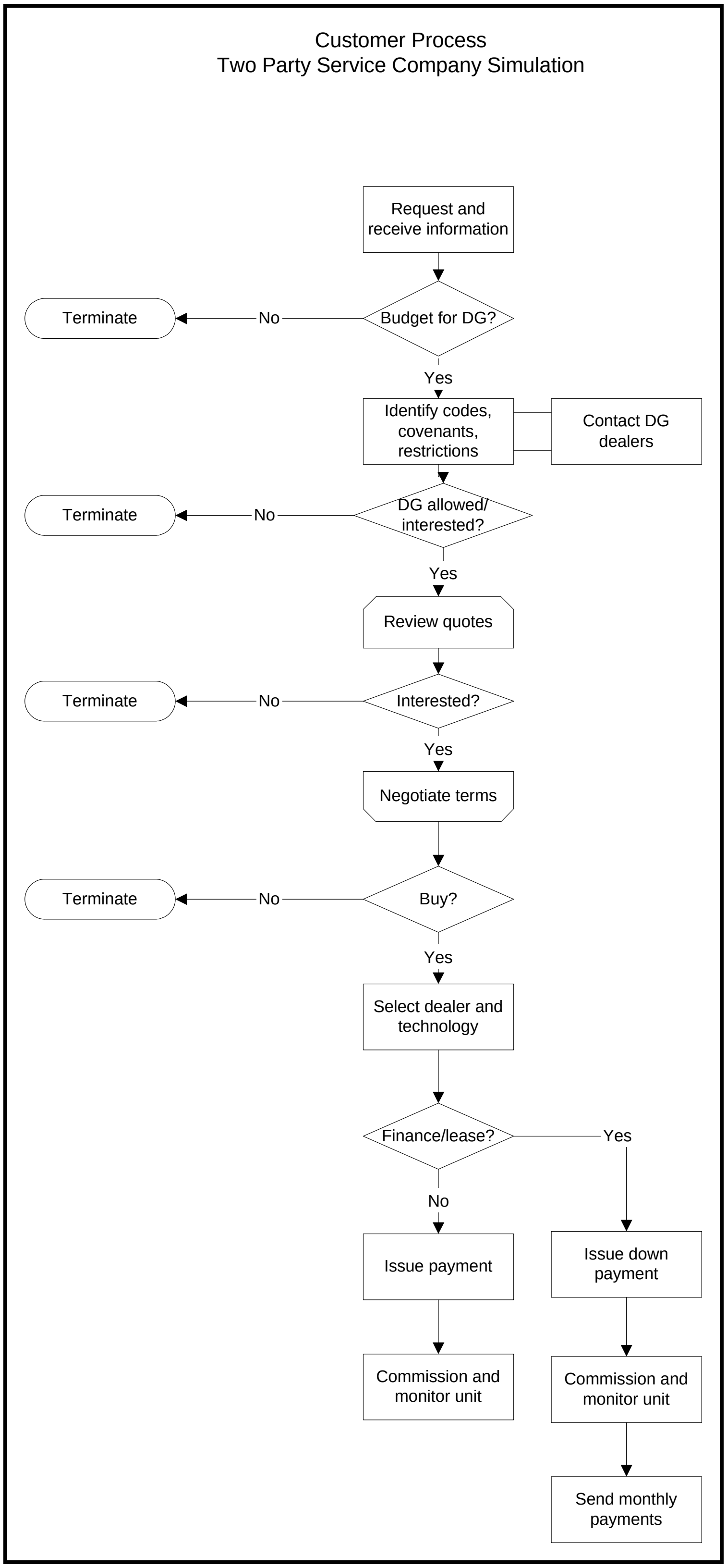
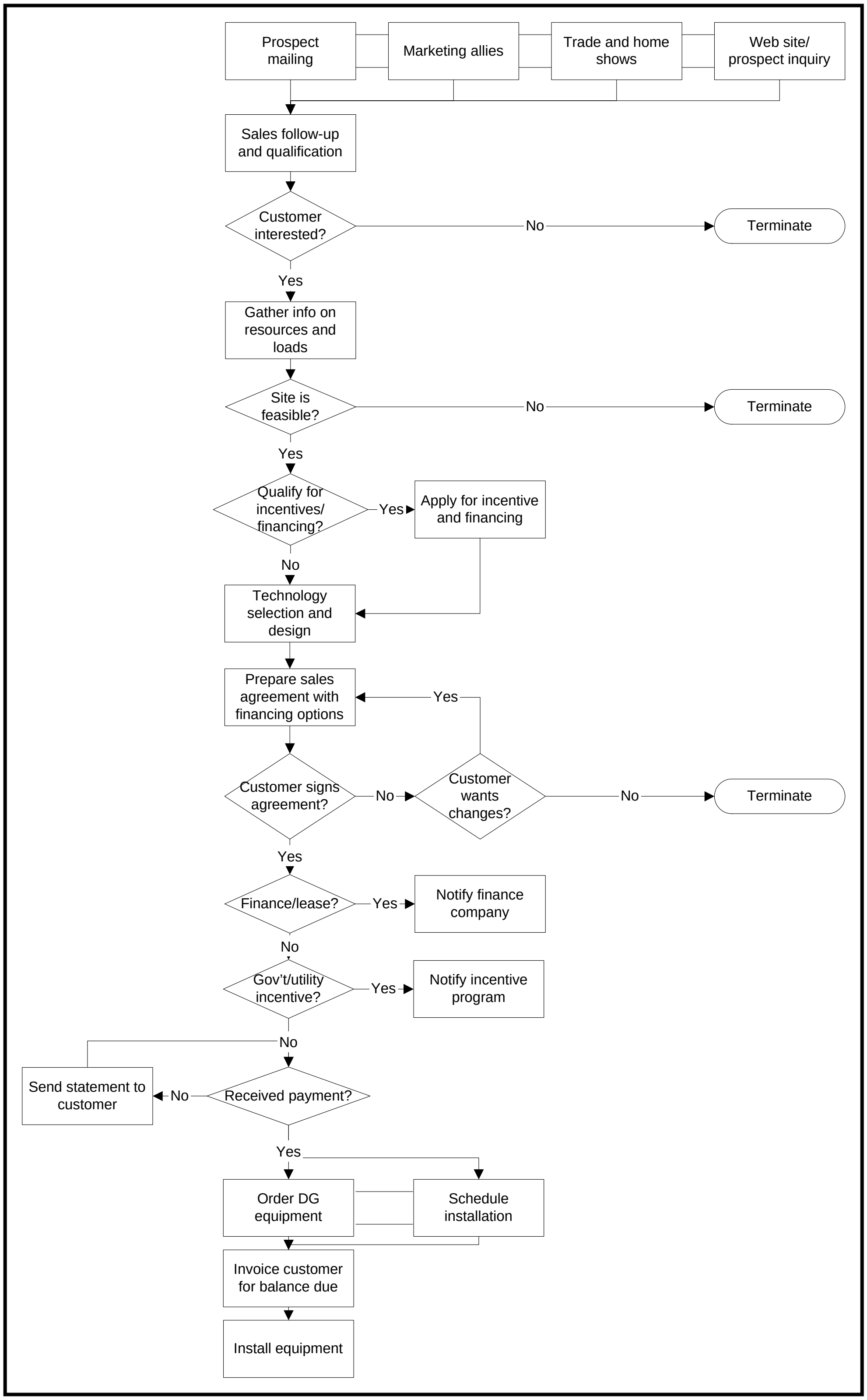


Figure 11: Complementary Energy Service Company/DG Dealer Process



3.2 Reducing Cost per Sale and Total Transaction Costs

Simulated Residential Process

The process map in Figure 12 describes the overall process that was simulated for the two-party customer transaction. The qualified lead generation process assumes direct marketing practices targeted to True-Blue Greens and Greenback Greens segments with an appropriate message. The site inspection and sales process assumes a thirty-minute site inspection, a thirty-minute follow-up process by phone, and a on-site software tool that selects appropriate technology and produces a sales quote at the time the site inspection is done. The site installation process assumes plug-n-play technology that takes four hours to install a residence. Finally, the customer service process assumes monthly billing and meter reading if the sale is for energy as opposed to equipment. That is, if the business model follows the utility model of the energy service company owning the equipment and selling power to the customer, then the customer is billed only for the power generated by the unit and not for the cost of the unit itself. The cost is recouped in the price of energy.

Table 2 lists the costs for this simulated process. The second column shows the costs by process for a residential scale DG unit in a one-way grid installation. Assuming a unit cost of $1,000/kW and a 1.5 kW unit, the cost as a percentage of the DG unit is shown in the third column. The cost per sale under this simulated process is $150, or 10% of the DG unit cost. The installation cost, including scheduling of the installation is $360, or 24% of the DG unit costs. The overall transaction cost is around $520, or 35% of the DG unit cost. Obviously, installation costs are the biggest portion of the transaction and are not likely to drop until houses are built or retrofitted for one-way grid connection. The 10% cost per sale under this process is in-line with direct marketing standards. Total price to the customer could be as low as $2,100, providing a reasonable capital cost for household budgets that is similar to the cost of a furnace or air conditioner.

Figure 12: Simulated Energy Service Company Process - Residential

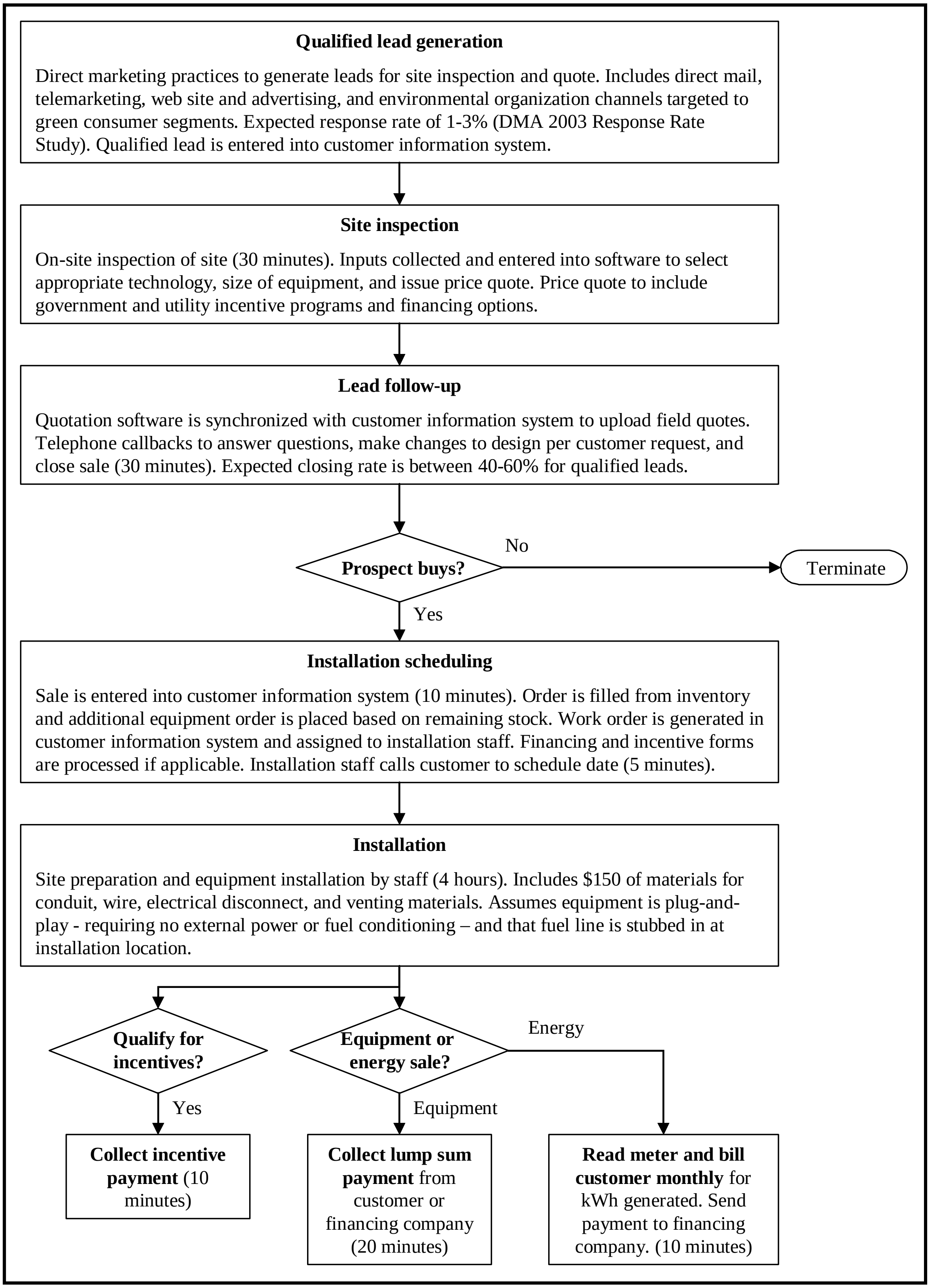


Table 2: Costs for Simulated Residential Process of 1.5 kW unit priced at $1,500.

Process	Simulated Process Cost	 Cost as % of Unit Cost
Qualified lead generation: 200 pieces direct mail @ $0.302/piece (flats 5-digit automation postal rate)	***$60.40*** to generate 2 leads	***4.03%***
Site inspection: 2 sites @ 30 minutes/site. Loaded hourly rate of $45.	***$45.00*** for 2 inspections	***3.00%***
Lead follow-up: 2 leads @ 30 minutes/lead for phone callback and uploading field quotation to customer info system.	***$45.00*** for 2 follow-ups and close 1 sale.	***3.00%***
Cost per sale	**$150.40**	**10.03%**
Installation scheduling: Entering 1 sale in system @10 minutes. Processing incentive and financing forms if applicable @ 10 minutes. Scheduling installation date @ 5 minutes. Total of 25 minutes @ $25/hour.	***$10.42*** for 1 installation	***0.69%***
Installation: 1 installation @ 4 hours. Loaded hourly rate of $50/hour. Materials cost of $150.	***$350.00*** for 1 installation	***23.30%***
Collect incentive payment: 1 incentive payment @ 10 minutes @ $25 loaded hourly rate.	***$4.17*** For 1 collection	***0.28%***
Collect lump sum payment: 1 payment from customer or financing company @ 20 minutes @ $25 loaded hourly rate.	***$8.33*** For 1 collection	***0.56%***
Monthly billing: 1 account @ 10 minutes per month @ $25 loaded hour rate.	***$4.17*** per month for 1 account	***0.28%***
Total – incentivized equipment sale	**$523.32**	**34.86%**
Total – incentivized energy sale	**$514.99 + $4.17/month**	**34.30%**

Simulated Small-Scale DG Commercial Process

The process map in Figure 13 shows the overall process that was simulated for the two-party commercial customer transaction. The only differences between the current and simulated processes are (1) one-way grid application rather than two-way grid-interconnected, and (2) incentive programs that flow through energy service companies to end-users rather than directly to them. In short, we found that small-scale DG is an awkward value proposition, in that the sales process requires a highly-trained and compensated sales force and expensive application engineering but the revenue per sale remains relatively low due to the small size of the unit.

The qualified lead generation process assumes a direct sales force combined with direct marketing practices. The key to keeping down costs is immediate lead qualification and efficient routing of sales force. The current application engineering process is retained in the simulation, since grid-isolated applications require careful consideration of matching DG output capabilities with end-use electrical and thermal load profiles, although the process is meant to only accommodate site specific peculiarities from a standard design. The customer service process assumes monthly billing and meter reading if the sale is for energy as opposed to equipment.

Table 2 lists the costs for this simulated process. The second column shows the costs by process for a commercial scale DG unit that is one-way grid connected. Assuming a unit cost of $1,000/kW and a 60 kW unit, the cost as a percentage of the DG unit is shown in the third column. The cost per sale under this simulated process is $4,681, or 7.8% of the DG unit cost. The simulated installation cost, including application engineering, is $14,000, or 23% of the DG unit costs. The overall transaction cost is around $18,715, or 31% of the DG unit cost.

Obviously, these simulated costs are very sensitive to the estimated installation costs which are very site dependent. Further, with commercial applications the size of the DG unit can very substantially which also effects installation costs. According to the NRECA CRN – DOE microturbine demonstration program, doubling the size of the unit reduced installation cost per kW by 35% for units in the 30 kW to 80 kW range (presentation at the Distributed Generation Resource Meeting, Cooperative Research Network of the National Rural Electric Cooperative Association, January 2002).

Figure 13: Simulated Energy Service Company Process – Small Commercial

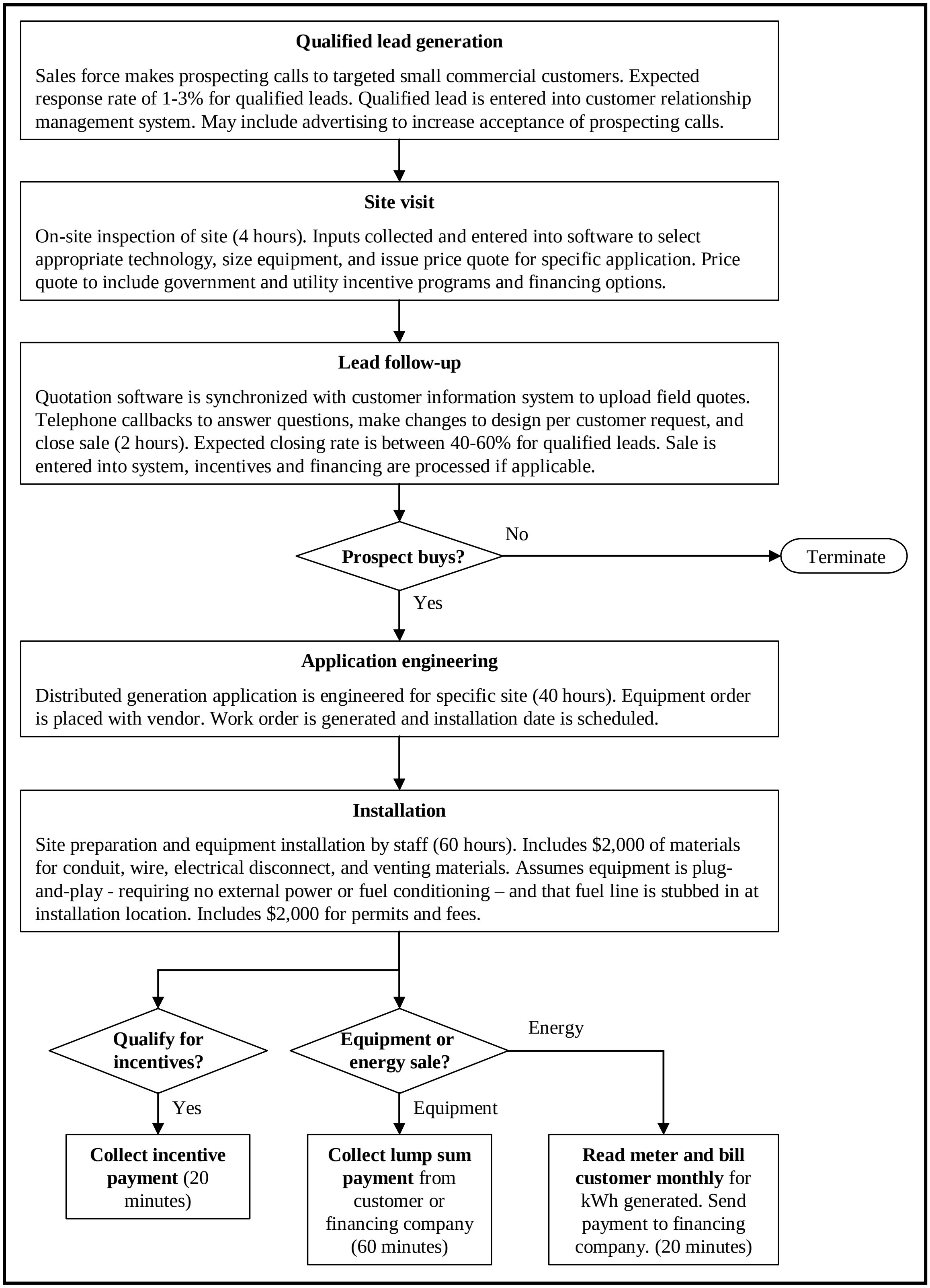


Table 3: Costs for Simulated Commercial Process of 60 kW Unit Priced at $60,000.

Process	Simulated Process: Cost	Simulated Process: Cost as % of Unit Cost
Qualified lead generation: 100 targeted prospect calls @ 30 minutes/call @ $75 loaded hourly rate	***$3,750.00*** to generate 2 leads	***6.25%***
Site visit: 2 sites @ 4 hours/site. Loaded hourly rate of $75.	***$600.00*** for 2 visits	***1.00%***
Lead follow-up: 2 leads @ 2 hours/lead for phone callback and uploading field quotation to customer info system. Entering 1 sale in system @15 minutes. Processing incentive and financing forms if applicable @ 30 minutes. Total of 4.25 hours @ $75/hour and 0.5 hours @ $25/hour.	***$331.25*** for 2 follow-ups and close 1 sale.	***0.55%***
Cost per sale	**$4,681.25**	**7.80%**
Application engineering: 40 hours @ $100 loaded hourly rate.	***$4,000.00*** for 1 installation	***6.67%***
Installation: 1 installation @ 60 hours. Loaded hourly rate of $100/hour. Materials cost of $2,000. Permits and fees @ $2,000.	***$10,000.00*** for 1 installation	***16.67%***
Collect incentive payment: 1 incentive payment @ 20 minutes @ $25 loaded hourly rate.	***$8.33*** for 1 collection	***0.01%***
Collect lump sum payment: 1 payment from customer or financing company @ 60 minutes @ $25 loaded hourly rate.	***$25.00*** for 1 collection	***0.04%***
Monthly billing: 1 account @ 20 minutes per month @ $25 loaded hour rate.	***$8.33*** per month for 1 account	***0.01%***
Total – incentivized equipment sale	**$18,714.58**	**31.19%**
Total – incentivized energy sale	**$18,689.58 + $8.33/month**	**31.15%**

What is interesting to note is that cost per sale for even these small-scale commercial units is around 10% of unit cost if the sales force can meet the following metrics:

- two percent of prospecting calls yield qualified leads;
- these prospecting calls take no more than thirty minutes each;
- site visits to follow-up on the qualified leads take no more than four hours each;
- during the site visit a conceptual proposal is produced for a specific application and technology at the site;
- upon leaving the proposal the phone follow-up requires no more than two hours to either get acceptance or rejection of the proposal; and
- fifty percent of qualified leads are closed as sales.

3.3 One-Way Grid Installation

Small-scale DG applications are configured to operate in parallel with or independent of the central power grid. Grid parallel applications can be designed to export excess power to the grid - in which electricity flows two ways – or as one-way applications in which the DG unit directly serves a load in parallel with the grid-supplied power, but no electricity flows back to the grid.

For both one-way and two-way grid parallel applications, any DG device that generates direct current (DC) must be interconnected through a static inverter that meets both the Institute of Electrical and Electronics Engineers (IEEE) Standard 929 and the Underwriters Laboratories (UL) Subject 1741. With these standards, inverters include functions necessary to synchronize safely and reliably with the grid, protecting power quality and preventing back-feeding during utility power outage. This protective equipment operates automatically without human intervention. Most, but not all, inverters produced today meet both the UL and IEEE standards.

Many companies involved in small-scale DG design and manufacturing are now developing plug-and-play units that use the latest in inverter technology and microelectronics. For example, most microturbines can be controlled locally by an onboard microprocessor or remotely through another computer, and some units use additional circuitry to start the microturbine and/or to switch from two-way to one-way grid-parallel operation.

Since these plug-and-play devices comply with the IEEE and UL standards, involvement of electric utility personnel in a one-way installation of small-scale DG is reduced to providing an approved list of DG units and inverters and a site inspection at the time of installation. In comparison, two-way installations require additional electric utility costs for meter installation, distribution and transmission studies and agreements for installations that include power supply agreements, and system upgrades to accommodate two-way flow and balancing of subsystem loads. It is these cost savings in studies and grid upgrades that, for small-scale DG, can outweigh the monetary gain in putting excess power back on to the grid. In addition, transaction time from planning to installation can be significantly cut by eliminating the need for studies of and upgrades to the grid distribution system.