The Dimensions of Perceived Market Barriers:
Factor-Analysis of Information Needs, Risks, and Hassles for Customers and Other Market Actors

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Abstract

In a baseline study for Pacific Gas and Electric (PG&E) and the California Demand-Side Management Advisory Committee (CADMAC), issues that appeared to be impediments to the purchase of premium-efficiency motors based on a series of focus groups were converted into 30 interview questions, which were categorized by hypothesized market barriers. Responses to these questions were subjected to an exploratory factor analysis, which yielded seven perceived barrier factors. The barriers identified were:

- Low Incentive
- Focus on Immediacy
- Downtime Concern
- Reluctant Investing
- Motor Sophistication
- Make-do Orientation
- Advanced System Orientation

These barrier factors provide a valuable guide to the perceptions and concerns about premium-efficiency motors among customers themselves. Accordingly, they can help clarify reactions to past motors programs as well as issues that must be addressed in future efforts. In addition, they offer the possibility of identifying important customer groups (on the basis of the patterns of factor scores) that may or may not have been addressed effectively in the past and that should be targeted for future programs.

The identified barriers do not vary systematically by territory or program exposure, but they do vary by amount of utility contact. The correlation between utility contact and barriers is equally true in both the PG&E and no-program comparison territories.

The barriers are more strongly related to Purchase Intentions, with all seven correlations with this variable statistically significant at the .05 level or better. The highest correlations were with:

- Make-do Orientation (-.388),
- Low Incentive (-.380), and
- Focus on Immediacy (-.335)

The results indicate that the barrier factors developed from the focus groups appear to capture something in the intention to purchase efficient motors. It will be important to continue this line of studies by systematically segmenting barrier factor scores by customer type to facilitate targeting future programs and designing their promotional, delivery, and financial components. In particular, several of the barrier factors seem to be rooted in customer characteristics, and are consistent with the descriptions provided by market actors in the focus groups. A clear example is the dichotomy between the high-use customer sophisticated in motors and systems and the low-use customer who treats motors as off-the-shelf commodities, thinks only in terms of

immediate needs and problems, and perceives a laundry list of traditional barriers, including hassle costs, doubts about payback, concerns about performance, and financing obstacles.

Introduction

We need a clear understanding of barriers to guide market transformation program designs and evaluations. Otherwise, we risk addressing programs to haphazardly selected barriers and markets. Moreover, without that understanding we are unlikely to generate the systematic evaluations that will permit cost savings and projectable results.

The paper presented here describes an empirical approach to the identification of barriers, based on the perceptions of those customers and other market actors who are directly engaged in the "push" and "pull" activities of exchange. It further proposes that such empirical information replace the *ex cathedra* descriptions of markets that are currently guiding the expenditures of public goods charges.

As helpful as the Eto, Prahl, and Schlegel (EPS) classification effort is as a guide, it suffers from several flaws, including. a) It is not derived from a consistent theoretical model, but is an *ad hoc* compilation of problems faced by end-users and other market actors in specific cases. b) The barriers listed are not mutually exclusive, nor are they exhaustive. For example, EPS combines concepts that other writers have kept separate (e.g., "hassle costs" and "transaction costs") or notes "close relations" between barriers. c) The list mixes barriers at different levels of discourse, affecting different levels of market actors.

In attempting to reconcile the EPS barriers with "real-world" market barriers as described by customers in several projects for CADMAC, we used the results of focus groups to develop batteries of survey questions for customers and other market actors regarding the presence of specific manifestations of the hypothesized EPS barriers in particular markets. Standard factor-analytic tools were applied to the survey data for the purpose of identifying underlying dimensions of variation among the hypothesized barriers. Factor scores were then computed and compared across groups expected to differ in their susceptibility to those barriers (e.g., because of the programs to which they had been exposed).

This approach was used in three studies. We applied it initially to a study of the market effects of Southern California Edison's C/I programs, developing questions that were designed to address each of the specific market barriers enumerated in the EPS Scoping Study. As a result of that initial study we realized, however, that it was important to pose questions about barriers not from the point of view of those assessing the market, but in terms of the perceptions of the market actors themselves. In subsequent projects for CADMAC we attempted to use focus groups with market actors to let them tell us how they thought about market barriers.

We used this latter approach in two studies for PG&E: a baseline assessment of the commercial packaged air conditioning and 10-100 horsepower motor markets, and a market characterization of the supermarket industry. While this paper incorporates our experiences with all these studies, it draws its example primarily from the baseline assessment of the motors market.[1]

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[1] It should be noted at the outset that the motors assessment was just half of the baseline study – which was not a huge study to begin with and, as a baseline study, covered much more than just perceived market barriers. Recognizing that there are always

For the motors baseline assessment, a key to our approach was to link market interventions to changes in perceived barriers and to actual or planned replacement actions taken. The framework within which we conceptualized the study was inspired by the EPS Scoping Study, which describes the adoption of energy-efficient technologies as being impeded by market barriers. Programs or other market interventions can be thought of as targeting one or more of these market barriers to affect the rate of customer (or other market actor) technology adoption.

Thus, while we believe it is essential to measure market effects through changes in observed behavior associated with market interventions, it is equally important to determine *why* behavior has or has not changed, since this has profound implications both for program design and for assessing the permanence of observed change. By identifying and measuring market barriers and their change over the course of a program, and by connecting the changes in market barriers to changes in customer choices, it is possible to "explain" the customer changes with the market barrier changes.

To implement this approach, we began with focus groups with motors dealers and manufacturers, in which in-depth discussions were initiated regarding their own and their customers' perceptions of energy efficient technologies. Using the judgment of the study team, the observations of focus group participants were used to develop a set of 30 questions to assess current customer perceptions of 10 barriers to premium efficiency motors in the market place. We intended to write three questions for each barrier, but in the end only 3 hypothesized barriers were thus represented; six barriers were measured by two questions; and one was measured with five questions.

Market Barriers, Program Exposure, and Purchase Intentions

It was hypothesized that customer perceptions of market barriers to purchasing energy-efficient motors would be a factor in their decisions about those purchases and that PG&E programs may have influenced perceived market barriers. We also believe that knowledge of the barriers that appear to influence purchase intentions will be valuable for planning future market interventions.

We started with several hypotheses regarding program exposure, barrier perceptions, and purchase intentions:

1. All of the barriers would be negatively related to program exposure; i.e., the more program exposure a company has had, the lower the perceived barriers should be.
2. All of the perceived barriers would be negatively related to willingness to install premium efficiency motors.
3. Some barriers would be more affected by program exposure than others.

The principles behind these expectations were that, while a wide array of PG&E programs have been delivered over the years, two aspects were common to the most widely know programs: Promotion; i.e., convincing customers of the value of energy-efficient motors equipment, and Rebates; i.e., assistance in the first-cost problems associated with purchasing energy-efficient motors. The intensity or level of barriers most related to these aspects of the PG&E programs would therefore be most correlated with program exposure.

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resource constraints, we nevertheless feel obliged to point out that those constraints limited the application of what is admittedly a relatively data and analysis-intensive approach.

To test these hypotheses telephone interviews were completed with 100 decision-makers in PG&E territory and 100 in a "no-program" comparison territory. For this analysis, three types of variables were involved: program exposure; perceptions of market barriers; and purchase intentions.

Program Exposure
Several questions were used to address the level of program exposure. For any customer, the most fundamental measure of program exposure was whether or not the customer was served by PG&E, in that everyone in PG&E territory has been exposed to some level of PG&E intervention. However, more specific measures were also obtained. One question asked respondents how often they had had contact with their utility by phone or in person in the last year. Another measure of PG&E exposure combined the territory variable and the utility contact variable. (The measure was coded 0 for all respondents outside of the PG&E territory; within the PG&E territory, the exposure measure was coded with the value of the utility contact variable.)

A third measure of exposure was also used. This measure is based on the same information contained in the second measure, but with additional information from program tracking system files to identify respondents who had participated in PG&E programs. Of the PG&E territory sample, 18 percent were recorded in program tracking system records. This measure of PG&E exposure is distinguished by indications of specific program participation.

Perceived Market Barriers
As described above, perceived market barriers were measured by asking 30 questions of each respondent.[2] The QC team expected substantial correlation among the identified barriers, but hypothesized the existence of 10 barriers based on the results of the focus groups and our review of the EPS barriers. As part of the overall plan, an exploratory factor analysis was completed to understand how they did vary together, empirically. A principal components analysis was done, using an orthogonal rotation. Initially, the rotated component structure did not converge. The problem was judged to be the presence of certain questions that had very small correlations with all other questions. There were eight such questions, and they were removed from the pool. With the new pool of 22 questions, convergence was achieved, and seven factors emerged, explaining 61 percent of the variance.

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[2] Many questions that address real barriers can also reflect realistic assessments of the impracticality of purchasing high-efficiency equipment. If the energy efficient option is not cost effective from the customer's perspective, no barriers would be considered to exist in the context of the EPS Scoping Study framework.

Exhibit 1

Abbreviated Items by Factors	Factor Loading	Cronbach's Alpha
I. Low Incentive		.72
Simplest to replace failed motor with one exactly like it	.695	
Too risky to experiment when have experience with others	.685	
Not sure enough about savings to justify extra cost	.614	
Doubt claims about payback	.572	
Energy usage under 50 hp too small to justify investment	.544	
We don't run motors enough hours to get good payback	.418	
II. Focus on Immediacy		.67
When motor breaks down want what's immediately available	.803	
We don't worry about equipment unless it breaks down	.775	
When motor breaks down no time to think about options	.582	
Too many other operations issues to consider energy costs	.564	
III. Downtime Concern		.71
Buying PE motors would require upgrading whole system	.781	
Supplier couldn't get PE quickly enough to avoid serious downtime	.746	
IV. Reluctant Investing		.46
Lack of access to financing keeps us from upgrading	.770	
Need outside financing to make additional investment	.569	
Must see in-field demonstrations before investing	.556	
V. Motor Sophistication		.39
We are very confident in selecting correct size and type	.829	
Most important thing is reliability	.676	
VI. Make-do Orientation		.36
Our practice is to rewind rather than purchase new motors	.839	
Prince of PE is well beyond what we're used to paying	.510	
VII. Advanced System Orientation		.19
Don't have time to learn about PE motors	-.506	
More useful to invest in re-engineering processes or controls	.775	

Exhibit 1 shows the 22 questions, grouped by the resulting seven rotated factors. The names are listed here in order of their eigenvalues: Low Incentive, Focus on Immediacy, Downtime Concern, Reluctant Investing, Motor Sophistication, Make-do Orientation, and Advanced System Orientation. These factors form the basis for most of the analyses that address perceived barriers in this study. The factors were subjected to a scaling analysis to determine internal consistency, as measured by the Cronbach's alphas shown.

These factors provide explanatory direction and potential marketing insights regarding both perceived barriers and target groups. First, the factors help us understand the types of barriers perceived by customers as impediments to the purchase and use of premium efficiency motors – as opposed to the barriers hypothesized by market analysts. Second, by associating them with customer reports, the barrier factors can be used to define important groups of customers who may or may not have been addressed effectively by earlier programs and should be targeted for future programs. These factors can also be tracked over time in future studies, to determine effectiveness of programs in reducing perceived barriers.

As an illustration of the first benefit of the factor analysis—the explanatory value of the factors—consider Factor I, Low Incentives, which refers here to the perceived *intrinsic* incentive for switching, rather than a low *extrinsic* incentive (rebates, etc.). We recognize in this factor that lack of awareness of the benefits of premium efficiency motors, uncertainty about their performance, and standard practices are tied to reflect a low level of incentives that is probably related to relatively low use of or reliance on motors. This analysis therefore helps to highlight problems for future marketing of premium efficiency motors; for example the need to identify the benefits of premium efficiency motors for a broader range of customers.

Similarly, in turning to Factor II, Focus on Immediacy, we recognize elements of the EPS bounded rationality barrier. This factor is probably high for customers who feel unable to deal with their equipment or production processes until a breakdown in normal operations occurs. The marketing implications are also clear—specifically, the need to reduce the perceived time and effort required to specify premium efficiency motors by customers who are enmeshed in other strategic and operational activities.
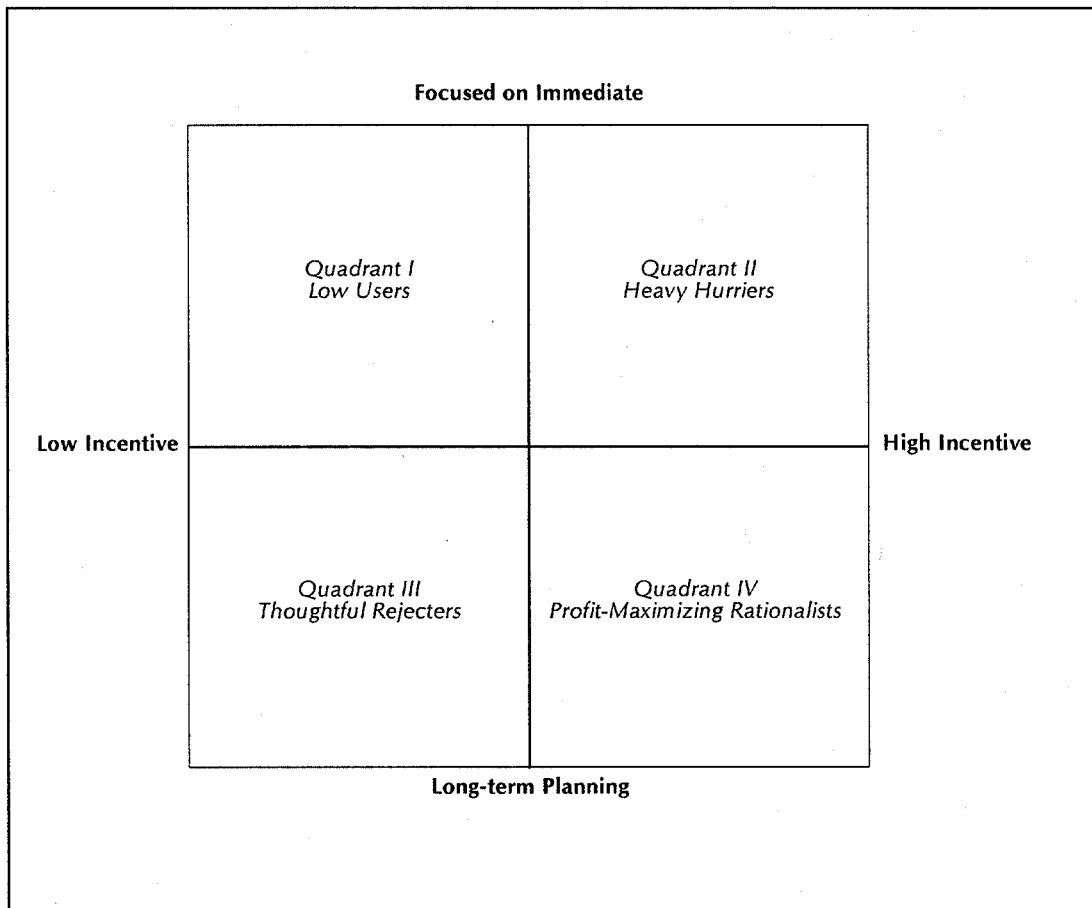
Thus, the factor analysis helps us identify which of the EPS hypothetical barriers appear to be operating in this market and the ways in which they might be addressed in future programs. The remaining factors[3] could be analyzed in like manner, both to understand barriers that appear to affect the market at this time and to develop implications for future marketing efforts.

The use of the factors for targeting can also be illustrated here.[4] For simplicity, we will restrict this example to the four segments that might be defined by the first two factors, relating to the size of the implicit incentives for selecting and using premium efficiency motors and the degree of focus on issues of immediate moment. As shown in Exhibit 2, the two independent factors define four hypothetical customer segments, one in each quadrant of the factor space. We describe each of these hypothetical segments and their program/marketing implications below— but we take the liberty of providing those descriptions in a dramatic, rather than numeric, order.

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[3] At least those that display a reasonable level of internal consistency on the Cronbach alpha criterion. Of these, Downtime Concern seems similar to the EPS barrier of lack of availability as perceived by the customer. Reluctant Investing represents elements of the EPS barriers regarding access to financing (together with the need for investment) and performance uncertainty. The Make-do Orientation contains aspects of organizational practices as well as bounded rationality. In other words, it represents the practice of taking the least expensive path, including purchasing at a lower first cost than premium-efficiency, and rewinding.

[4] The ideal method of identifying customer segments is through straightforward application of cluster analysis, using the factor scores. A less sophisticated approach would be through crosstabulation via those scores. Each survey respondent would be assigned the set of factor scores defined by his/her responses to the items comprising each factor, as weighted by the appropriate factor loadings (for those factors that are deemed reliable on the Cronbach alpha scores). A segmentation analysis would then be completed, and the resulting segments would be characterized according to the independent firmographic data, such as size, number of motors used, SIC code, etc. This analysis was not included here because of constraints relating to scope of work, timing, and budget resources.

Exhibit 2
Factor Dimensions and Customer Segments

Focused on Immediate

Quadrant I *Low Users*	*Quadrant II* *Heavy Hurriers*
Quadrant III *Thoughtful Rejecters*	*Quadrant IV* *Profit-Maximizing Rationalists*

Low Incentive   **High Incentive**

Long-term Planning

Quadrant I. Low Users

These customers recognize very little value to moving to premium efficiency motors. Moreover, they are focused on their immediate operational problems.

> This description seems highly consonant with the experience of account representatives, program managers, and market actors such as those in the focus groups: Many customers, especially those with few motors or motors that are not particularly important to their core business needs simply do not believe they use motors enough to gain significantly from worrying about their efficiency. Moreover, they do not even think about their motors until they fail. Programs targeted to this segment would appear to have to overcome both the barriers of awareness/interest and that of bounded rationality. Pure rebate programs may not be effective with such customers.

Quadrant IV. Profit-Maximizing Rationalists

These customers see considerable value to the selection and use of premium efficiency motors. Moreover, they are capable of and motivated to plan for selection of appropriate technologies in advance of an immediate need.

This group is the polar opposite of those in Quadrant I. Members of the segment probably include larger corporations, with systematic planning processes and sophisticated energy managers, many of which are heavily dependent upon motors for their core product/business or who have completed detailed analyses of the payback available from premium efficiency equipment. This segment appears to be a ready target for programs that assume customer attention and interest and focus on barriers later in the decision process, such as access to financing.

Quadrant III. Thoughtful Rejecters

Members of this segment are capable of and motivated to carry out sophisticated planning. However, they recognize little incentive for the selection and use of premium efficiency motors.

This group may include larger customers with sophisticated planning processes and perhaps even internal energy management staff. However, these companies probably do not depend to any significant degree upon motors in their core business. Many facilities, such as schools or lodging, might fit into this group, for which the only motors applications of note would include those involved in HVAC applications or elevators — which would be installed by OEMs, and not considered as independent purchases. This group may be large and highly resistant to any programs not designed with the OEM relationship clearly incorporated and leveraged.

Quadrant II. Heavy Hurriers

This group sees considerable value to the selection and use of premium efficiency motors. However, they are highly focused on issues of immediacy and do not take the time to plan for switching to premium efficiency equipment before a breakdown occurs.

Implicit in this description is the possibility that, despite recognizing the value of moving to a more efficient set of equipment, members of this group do not do so at the moment of crisis because the need to replace the failed motors immediately overwhelms their awareness of potential gains. Programs directed toward this segment probably need to be focused on methods for avoiding the perceived hassle of selection and purchase at the time of crisis, and may include such mechanisms as predesignated replacements, rapid response suppliers, etc.

As noted earlier, these segment descriptions are intended to be illustrative. We are confident that a full, systematic cluster analysis or segmentation analysis based on the barrier factors identified here is likely to provide well-grounded and useful directions for future analysis and marketing.

Purchase intentions

This variable was measured by a question that asked the respondent what type of motor would be purchased by the company if it were making a purchase today. Would they: 1) purchase the least costly available new motor that will do the job, 2) rewind the motor or install a rewound motor, 3) purchase a high efficiency motor (that meets EPACT standards), or 4) purchase a premium efficiency motor (that exceeds EPACT standards). Because the second response category does not obviously belong between responses 1 and 3 in terms of this ordinal energy efficiency scale, another version of the variable was tested, which combined the first two categories, thus allowing both to represent the non-energy-efficient choice. This modification did not have a significant impact on the results of any analyses.

Results

Impact of PG&E Exposure on Barriers

Next, we examined the correlations between the seven perceived barrier factors and three measures of exposure. While the overall relationship between territory and barriers was very weak, there are several consistencies worth noting.

Exhibit 3
Correlations of Seven Perceived Barrier Factors with Exposure Variables

Barrier	PG&E Exposure	PG&E Program Participation	Number of Utility Contacts
Advanced System Orientation	.201**	.120	.104
Low Incentive	-.091	-.062	-.183*
Focus on Immediacy	-.062	.006	-.230**
Downtime Concern	-.050	-.072	-.095
Reluctant Investing	-.018	.004	-.056
Motor Sophistication	-.005	-.064	.077
Make-do Orientation	.028	-.050	.070

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

The Low Incentive factor was consistently negatively related to each version of the Exposure variable, and the correlation between this perceived barrier and Utility Contact was statistically significant. This implies that those who have had more utility contact (in either territory, but most strongly for the no-program territory) are more likely to perceive value in premium-efficiency motors. (Presumably, also, they are less likely to be small, low-use customers, if the segmentation hypotheses are correct.. This would also be consistent with the fact that utilities are likely to target larger customers with high motor use.) Further, it is probable that as utility representatives talk with customers, they help them understand the contribution of motors to their total energy use and, accordingly, the savings available from energy efficiency.

The significant correlation between Focus on Immediacy and Utility Contacts, though not consistently negative across the three measures of exposure, is the largest one found, and it is highly significant. Customers who have high scores on Focus on Immediacy are less likely to work with utility representatives, as might be expected from the earlier discussions. (Again, from the segmentation orientation, they are probably also smaller, low-use customers and may well be high scorers on the Low Incentive factor.

These results are consistent with a picture that emerged in the focus groups with market actors. One of the conclusions of those groups was that the larger customers, who use many large motors as a central part of production, are already fully aware of premium-efficiency motors and are convinced of their value. They contrast with the customers who tend to use small motors and fewer of them. This latter group of customers generally treats motors as off-the-shelf commodities and have yet to be convinced of the value of premium-efficiency motors. The analyses using the derived factors seem consistent with this distinction. However, the factor

analysis adds considerable richness by suggesting the role of other barriers and the potential of identifying customer segments other than the two highlighted in the focus groups.

Impact of Barriers on Intentions

The study team expected that all of the perceived barriers would be related to purchase intentions. The results are shown in Exhibit 4.

Exhibit 4
Correlations of Barriers with Intentions
To Purchase Premium-Efficiency Motors

Barrier	Correlation with Intentions
Make-do Orientation	-.388**
Low Incentive	-.380**
Focus on Immediacy	-.335**
Motor Sophistication	.241**
Reluctant Investing	-.177*
Advanced System Orientation	.171*
Downtime Concern	-.165*

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

It is clear from the exhibit that the correlations are strong. All correlations but two are negative, and all are statistically significant. The two "barriers" that are positively correlated with intentions are consistent with predictions. Both the Motor Sophistication and the Advanced Systems Orientation are stated in positive terms, i.e., high scores mean sophistication and being advanced in thinking about systems. Since these orientations are most likely to be associated with consideration of premium-efficiency motors, as discussed earlier, it is the *lack* of these factors that can be described as "barriers" to these purchases. Given this, we would expect positive correlations with Purchase Intentions.

Implications for Evaluators and Program Managers

The study results described above show how factor analysis can be used to understand the underlying factors perceived by the market actors themselves as upstream or downstream barriers to the sales and use of energy-efficient products and services. This not only provides a guide to areas for program targeting, but also a convenient metric, comparable across service territories, for tracking the success of market transformation programs in conjunction with more extensive market surveys. It would thus indicate the areas to which program resources might usefully be devoted and the metrics against which progress should be assessed.

The empirical analysis of perceived barriers to the deployment of energy-efficient products and services would seem a reasonable requirement for both market baseline studies and for subsequent . However, the emphasis on empirical information is not meant to replace expert analysis. Surely market participants may fail to appreciate the importance of certain barriers or may perceive barriers that have been removed long ago. Expert analysis of the market is also only a partial view; triangulation by alternative approaches is clearly required. Moreover,

discrepancies—such as perceptions of barriers that have actually been removed—may signal the need for other intervention strategies, such as improved communication of resources available.