Impact Evaluations and Measurement and Verification

Net Savings

- savings determined due to the program

Net Energy Savings

- The primary, but not exclusive, considerations that account for the difference between net and gross savings are free riders and participant and non-participant spillover.
- Free riders are program participants who would have implemented the program measure or practice in the absence of the program. Free riders can be total, partial, or deferred.
- Spillover refers to reductions in energy consumption and/or demand caused by the presence of the energy efficiency program, beyond the program-related gross savings of the participants. There can be participant and/or non- participant spillover.

Assessing Free Riders

Table 5-1. Example Free Rider Probability Assessment

Free-Ridership Score	Already Ordered or Installed	Would Have Installed With-out Program	Same Efficiency	Would have Installed All of the Measures	Planning to Install Soon	Already in Budget
100%	Yes	Yes	—	—	—	—
0%	No	No	—	—	—	—
0%	No	Yes	No	—	—	—
50%	No	Yes	Yes	Yes	Yes	Yes
25%	No	Yes	Yes	Yes	No	Yes
25%	No	Yes	Yes	Yes	Yes	No
0%	No	Yes	Yes	Yes	No	No
25%	No	Yes	Yes	No	Yes	Yes
12.5%	No	Yes	Yes	No	No	Yes
12.5%	No	Yes	Yes	No	Yes	No
0%	No	Yes	Yes	No	No	No

Approaches for Determining Net Energy Savings, continued

Approaches:

- Self-reporting surveys
- Enhanced self-reporting surveys
- Statistical models that compare participants' and non-participants' energy and demand patterns
- Stipulated net-to-gross ratios

Some Thoughts on NTG?

- Attribution is obviously challenging
  - Precise attribution will always be difficult
  - Uncertainty should be communicated
- Results should be used to
  - Optimize program and portfolio design
  - Appropriately direct and motivate implementers, without
    - Penalizing for factors outside direct control
    - Creating perverse incentives
      - (e.g., maximizing short-term versus long-term impacts)
  - Improve forecasts and influence on procurement

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Cost Effectiveness

Cost-Effectiveness Perspectives

Benefits and Costs of Various Test Perspectives		
Tests and Perspective	**Energy Efficiency Benefits**	**Energy Efficiency Costs**
Participant Cost Test	Incentives from utility and others, plus reduction in electricity bill	Participants' direct cost of participation
Ratepayer Impact Measure	Avoided supply costs (production, transmission, and distribution) based on net energy and load reductions	Utility program costs (including administration costs plus incentives to participants) plus net lost utility revenues caused by reduced sales
Utility Cost Test (Also Called Program Administrator Cost Test)	Same as above	Utility program costs (including administration costs plus incentives to participants)
Total Resources Cost Test	Same as above plus benefits that do not affect the utility (e.g., water savings, fuel oil savings)	Utility program costs (excluding incentives to participants) plus net participant costs (prior to any cost reduction due to incentives from the utility)
Societal Cost Test	Same as above plus externality benefits; excludes some tax credit benefits	Same as above

Source: Guide to Resource Planning with Energy Efficiency, National Action Plan for Energy Efficiency, www.epa.gov/eeactionplan

Societal/Total Resource Cost Test

- Asks:
  - Is total resource or societal efficiency improved? Includes externalities.
- Costs:
  - Resource/program costs to utilities & participants
- Benefits:
  - Avoided energy & capacity costs to utilities and participants
  - Externalities (for Societal Test, not TRC)
- Transfers between parties not included
  - Incentives (rebates)
  - Lower energy bills / lost utility revenue

Societal/TRC Test

- Strengths
  - Scope (total costs & benefits)
  - Can be used to compare demand and supply options (if supply-side analysis included total costs of generation and transmission)
- Weaknesses
  - Does not include the effect of revenue reduction, which is an effect of DSM programs
  - Includes participant costs, which are not included in supply-side options

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Determining Avoided Emissions

Determining Avoided Emissions

The basic approaches:

- Applying emission factors (e.g., pounds of CO_2 per MWh) to net energy savings
- Using emissions scenario analyses, e.g., using computer models to estimate the difference in emissions from power plants with and without the reduced electricity consumption associated with an efficiency program.

Avoided Emission Approaches

Emission Factor Approach

- Multiplying the program's net energy savings by emission factors (e.g., pounds of SO_2 per MWh) that represent the characteristics of displaced emission sources to compute hourly, monthly, or annual avoided emission values (e.g., tons of NO_x or CO_2).
- *Avoided emissions = (net energy savings) × (emission factor)*

Scenario Analysis Approach

- Calculating a base case of sources' (e.g., power plants connected to the grid) emissions without the efficiency program and comparing that with the emissions of the sources operating with the reduced energy consumption associated with the efficiency program. This is done with computer simulation, dispatch models, models.
- *Avoided emissions = (base case emissions) – (reporting period emissions)*

Evaluation Issues Specific to GHG Emission Mitigation

- Defining additionality
  - Policy versus technical decision
  - A freerider can be total, deferred or even partial
  - Not necessarily defined the same for energy and carbon programs
- Defining boundaries – leakage
- Policy context
  - Capped system (set asides) versus uncapped systems (offsets) – real reductions a concern in capped systems
  - Programs versus projects
- Transaction costs - again “how good is good enough”

Market Level Evaluations

Baseline studies
Potential Studies
Market Effects Evaluation

MT: Market Transformation Basics

- MT: Long-lasting sustainable changes in the structure or functioning of a market achieved by reducing barriers to the adoption of energy efficiency measures to the point where further publicly-funded intervention is no longer appropriate.
- Often involve working "upstream" with manufacturers, retailers, etc.
- Can appear in conjunction with other strategies
- "Done" when the less efficient alternative is either unavailable, unprofitable, or 'illegal' (codes and standards).

Market Assessment and Market Transformation

- The goal of market transformation programs is to move a product or technology market along the "S" curve of market adoption either at an accelerated pace and/or to a higher level of adoption along the curve.

- In other words, market transformation programs seek to make products more accessible, through improved availability and lower pricing and/or better financing, so that more customers will buy and install them. They can also be used to "jump start" new technologies and/or accelerate the adoption of products.

"S" Curve of Market Transformation

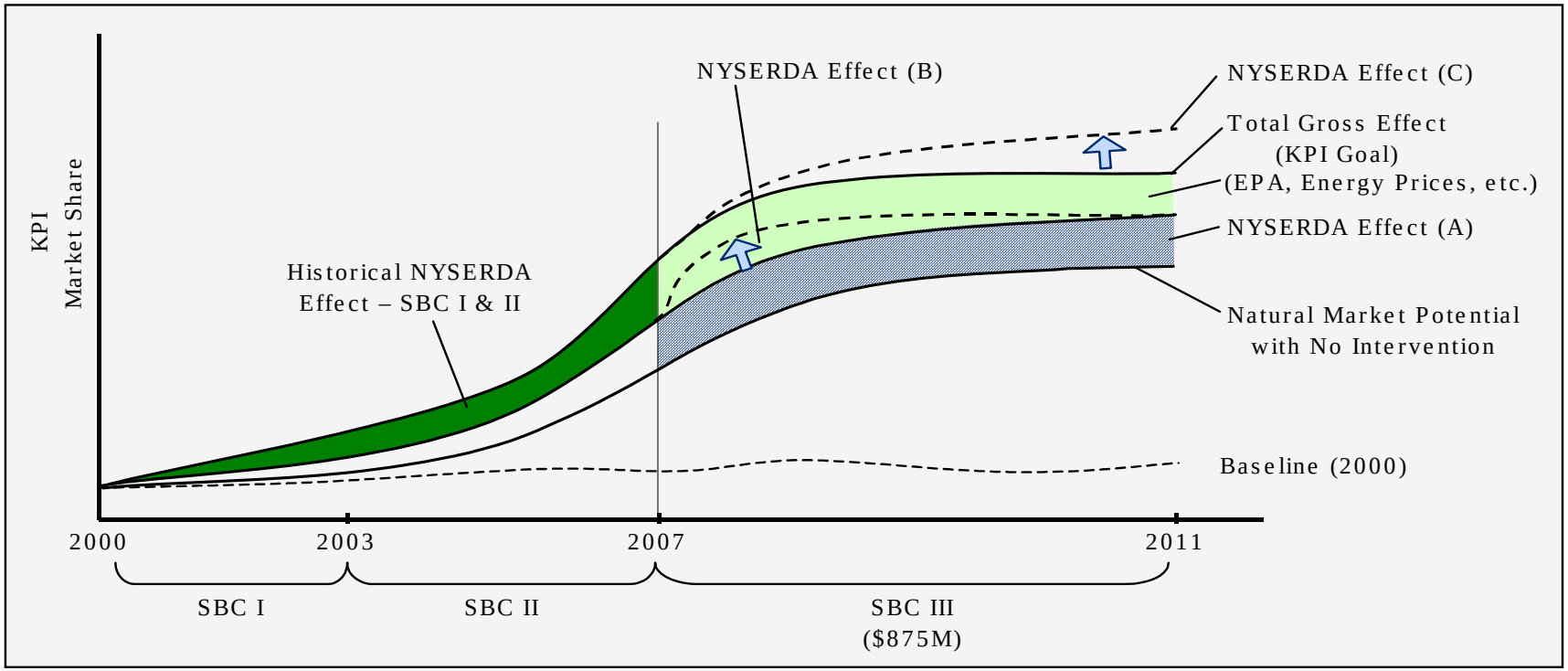
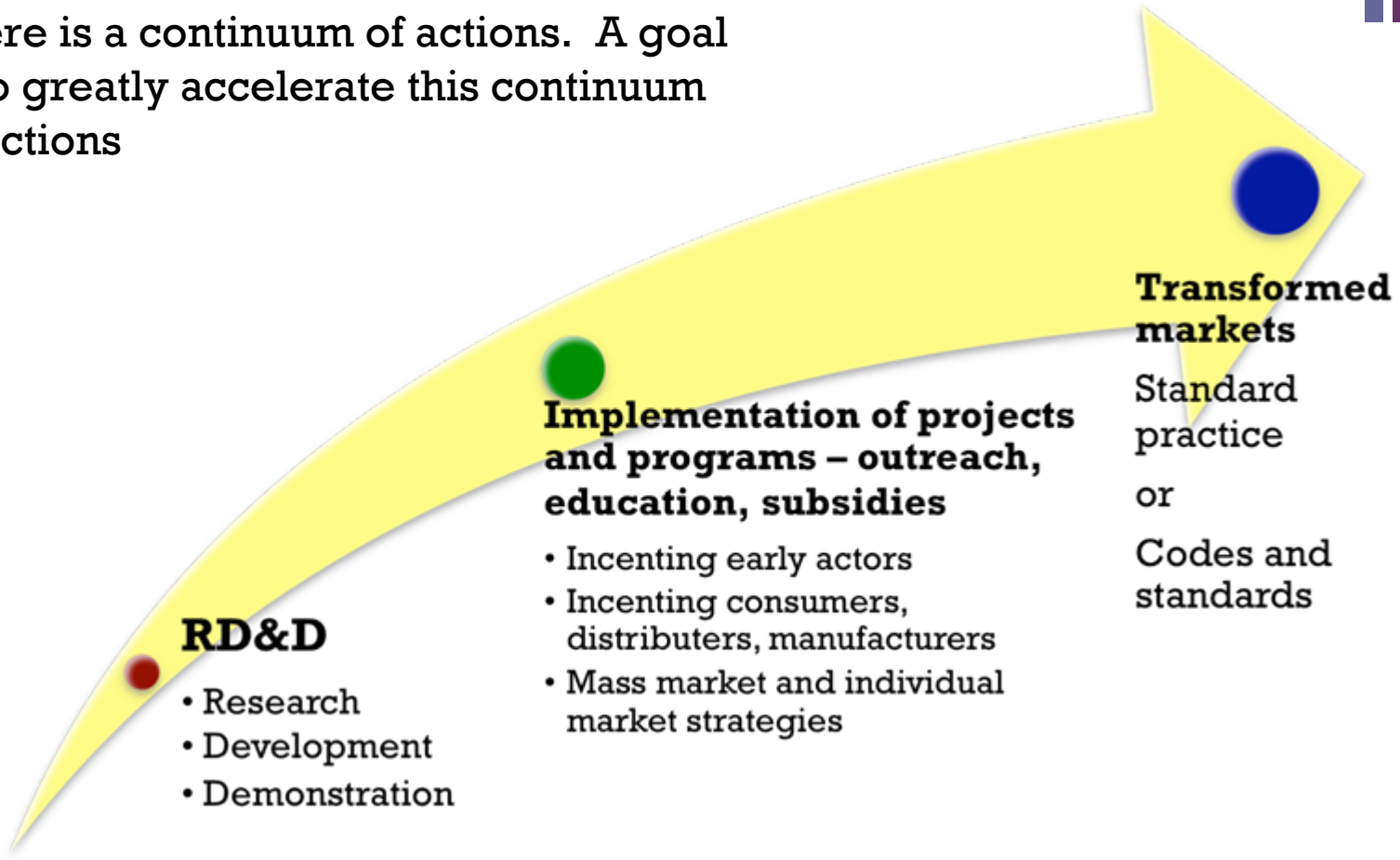


Figure 3: Schematic of "S" Curve of Technology/Behavior Adoption with

Determination of NYSERDA-Attributed Market Effects

End-Use Energy Efficiency Actions

There is a continuum of actions. A goal is to greatly accelerate this continuum of actions



Market Baseline, Potential, and Market Effects Studies

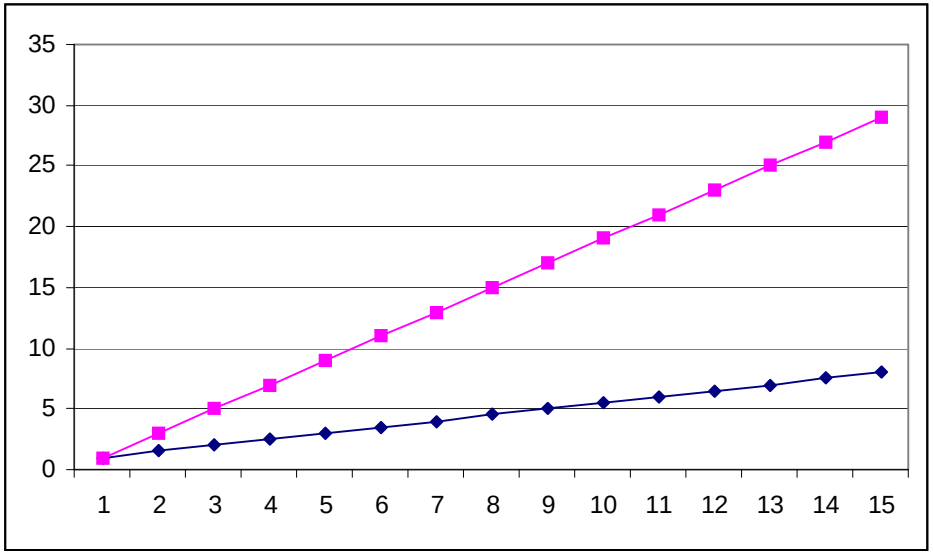
- Market baseline studies look at the broader market for EE products and services within which a program operates and establishes existing levels of efficiency – done before program

- Potential Studies – savings potential – done before program
  - Technical potential
  - Economic potential
  - Market potential

- Market Effects - looking at the broader market effects of an EE program (e.g., sometimes rebate programs may increase product availability and drive product prices down, resulting in…)

Market Baseline (Characterization) Studies

- Each program or portfolio can utilize baseline measurement to characterize what the market (or household or business) looked like before the program intervention.
- Part of formative evaluation—conduct before finalizing program design
- To measure change, must know the starting conditions.
- Unfortunately, people often don't think of this until the program has already been running a few years.



Market Indicator Examples

- Market audience awareness and knowledge of products/services/practices and benefits/values
- Market share/penetration
- Repeat purchase/persistence
- Product Availability
  - Can be purchased through existing market/distribution channels
  - Shelf space or other metric of inventory % increases
  - Units produced
- New market actors emerge/existing market actors begin to supply
- Market actors/partners promoting the product/service/technology, as evidenced by marketing communications, programs, and/or dollars spent
- Price of products
- More stringent standards/codes

(Source: NWEEA)

Process Evaluations

Process Evaluation

- Assesses the process a program undergoes during implementation
- Documents program goals and objectives from a variety of perspectives
- Describes program strengths and weaknesses so that success is highlighted and improvements can be made

Purpose of Process Evaluation

- To recommend ways to improve a program's efficiency and effectiveness (both implementation and cost-effectiveness)

- Frequency:
  - For a new program
  - Whenever there are major changes in the program
  - Or after 2-3 years

Process evaluations are particularly valuable when:

- The program is new or has many changes
- Benefits are being achieved more slowly than expected
- There is limited program participation or stakeholders are slow to begin participating
- The program has a slow startup
- Participants are reporting problems
- The program appears not to be cost-effective

Elements of a Process Evaluation

- Program Design
  - The program mission
  - Assessment of program logic
  - Use of new practices or best practices
- Program Administration
  - Program oversight
  - Program staffing
  - Management and staff training
  - Program information and reporting
- Program Implementation
  - Quality control
  - Operational practice — how program is implemented
  - Program targeting, marketing, and outreach efforts
  - Program timing
- Participant Response
  - Participant interaction and satisfaction
  - Market and government allies interaction and satisfaction