11.07.2011

US DOE Computational Tools for Smart Grid and Energy Storage

EU-US cooperation on Smart Grid assessment methodologies

The Smart Grid Computational Tool (SGCT) is an Excel based tool for identifying and quantifying smart grid project benefits.

Characterize the Project
- The SGCT characterizes smart grid (SG) projects by identifying the technology that will be installed and identifying what that technology will be do.

Identify Benefits
- Based on this characterization the SGCT identifies the economic, reliability, environmental and security benefits the SG project will yield.

Guide Data Entry
- Guides the user to enter data which is used to calculate the monetary value of benefits.

Prepare and Present Results
- Prepares graphs and tables that summarize the costs and benefits of the project to help illustrate the project's overall value.

The primary purpose of the SGCT is to account for benefits delivered by a smart grid project.

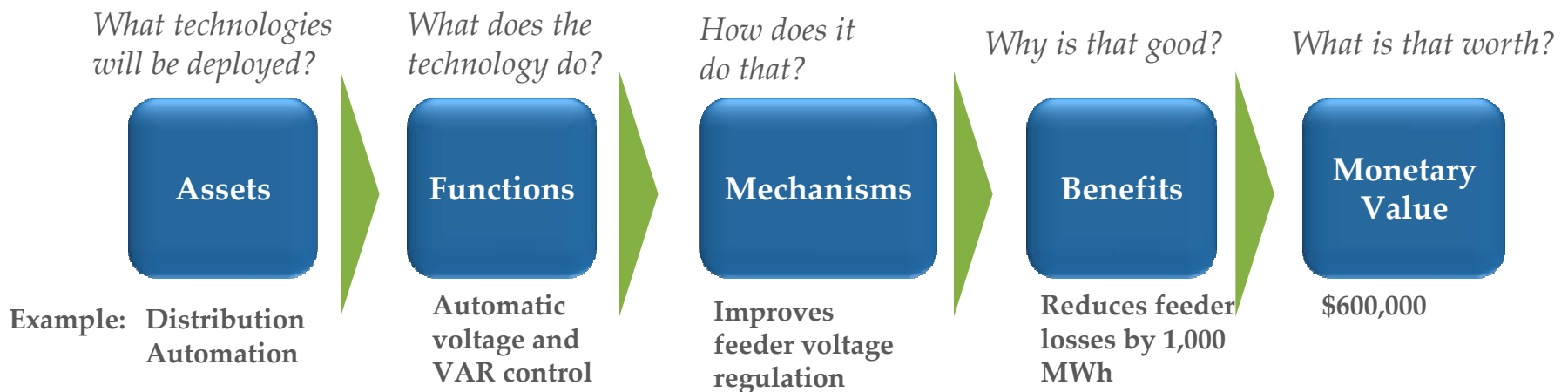## Account for Project Benefits and Value (Backcasting)

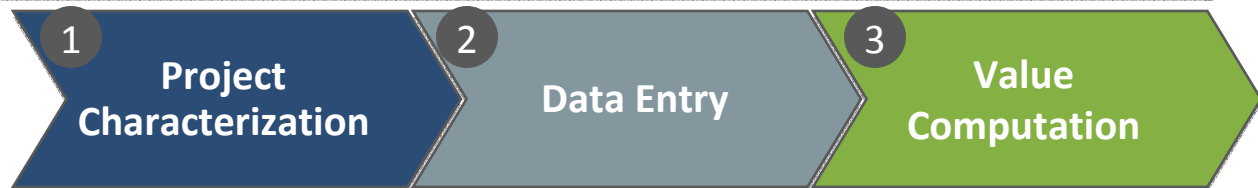| What the SGCT does	What the SGCT could be used for
• Analyzes an operational project • Inputs are measured data and reflect actual performance • Translates inputs into monetary benefits and projects results forward • Results represent actual project value.	• Quantify the benefits of the SG project or technology • Compare costs and benefits of a SG project • Identify the key drivers of realized benefits • Refine metrics data collection approaches for tracking benefits

The process of analyzing a smart grid deployment can be summarized with a series of questions.

What technologies will be deployed?	*What does the technology do?*	*How does it do that?*	*Why is that good?*	*What is that worth?*
Assets	**Functions**	**Mechanisms**	**Benefits**	**Monetary Value**

Example: Distribution Automation → Automatic voltage and VAR control → Improves feeder voltage regulation → Reduces feeder losses by 1,000 MWh → $600,000

SGCT modules reflect the activities involved in assessing the value of a smart grid project.

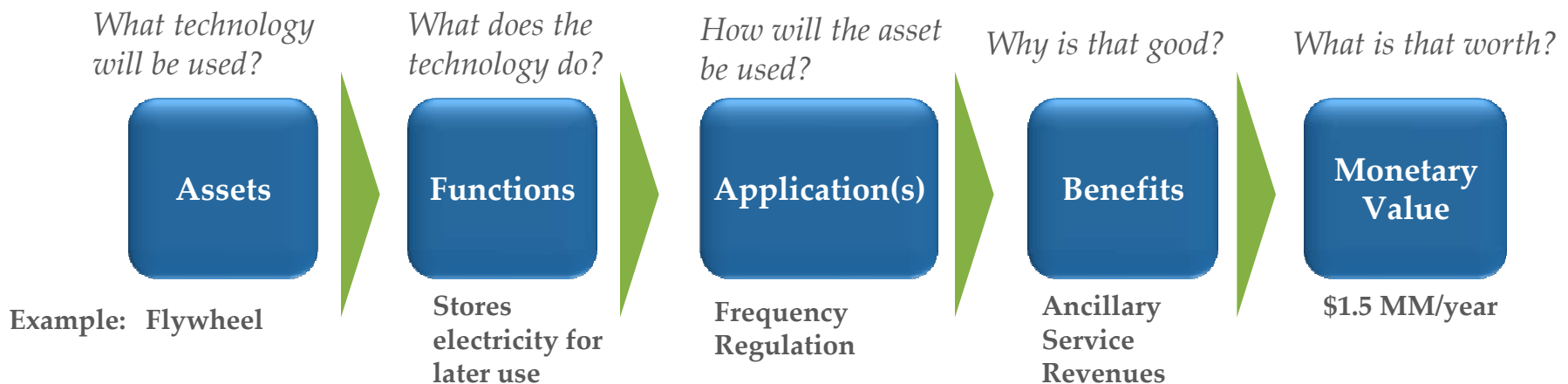| The SGCT is composed of three modules.		
1 Project Characterization	**2 Data Entry**	**3 Value Computation**
Purpose Determine the list of project benefits.	Filter irrelevant metrics. Guide and assist data entry.	Calculation engine. Present results.
Inputs Assets, Functions, Mechanisms	List of Benefits	Calculation Dataset, Sensitivity Ranges
Outputs List of Benefits	Calculation Dataset	Tabular and Graphic Presentation of Monetized Benefits.
Key Methodologies Asset-to-Function and Function-to-Benefit Relational Models	Benefit-to-Input Relational Model	Smart Grid Benefits Calculations, Benefit Forecast Methodology

The Energy Storage Computational Tool (ESCT) is a simplified version of the SGCT with a focus on calculating ES specific benefits.

- The ESCT is built on the structure of the SGCT but has a greater ability to identify and quantify ES benefits because:
  - It only contains content relevant to energy storage (ES)
  - It delves into greater detail concerning the location, market and application of ES assets
  - The rationale for ES benefits is rigorously defined
  - The energy storage calculations are more detailed

The ESCT is an Excel based tool for identifying and quantifying ES project benefits.

Characteristics of the ESCT		Advantages
Purpose	The tool guides the user through the analysis and accounts for benefits and costs of an operational project.	• Straight forward to use • Lends itself to QC • Provides a consistent and credible method for identification and calculation of benefits • Ensures consistency of results • Well suited for long term analysis
Method of Use	The analysis is conducted in Excel and can be saved, edited, and updated.	
Analytical Rigor	The tool leverages a peer reviewed framework that consistently identifies and calculates ES benefits.	
Calculations	The tool uses standardized benefit calculations.	

The process of analyzing an ES deployment can also be summarized with a series of questions.

What technology will be used?		*What does the technology do?*		*How will the asset be used?*		*Why is that good?*		*What is that worth?*
Assets	→	**Functions**	→	**Application(s)**	→	**Benefits**	→	**Monetary Value**

Example: Flywheel   Stores electricity for later use   Frequency Regulation   Ancillary Service Revenues $1.5 MM/year

In order to fully define the applications and benefits of a specific ES project, several additional details must be specified.

On what part of the grid is the asset located?

Location

Is the asset in a regulated market?

Market

What ES technology will be used?

Technology

Who will own the ES device?

Owner

How will the asset be used?

Application(s)

Why is that good?

Benefits

What is that worth?

Monetary Value

The ESCT leverages the energy storage applications developed by Sandia National Labs.

ENERGY STORAGE APPLICATIONS
Electric Energy Time Shift
Electric Supply Capacity
Load Following
Area Regulation
Electric Supply Reserve Capacity
Voltage Support
Transmission Support
Transmission Congestion Relief
T&D Upgrade Deferral
Substation Onsite Power
Time-of-Use Energy Cost Management
Demand Charge Management
Electric Service Reliability
Electric Service Power Quality
Renewables Energy Time Shift
Renewables Capacity Firming
Wind Generation Grid Integration – Short Duration
Wind Generation Grid Integration – Long Duration

Reference Document – *Energy Storage for the Electricity Grid: Benefits and Market Potential Assessment Guide* (SAND2010-0815, February 2010)
http://www.smartgrid.gov/sites/default/files/resources/energy_storage.pdf