Unit-V

Smart Consumptions and Regulations

Net metering

Net metering is a billing mechanism that credits solar energy system owners for the electricity they add to the grid. For example, if a residential customer has a PV system on their roof, it may generate more electricity than the home uses during daylight hours. If the home is net-metered, the electricity meter will run backwards to provide a credit against what electricity is consumed at night or other periods when the home's electricity use exceeds the system's output. Customers are only billed for their "net" energy use. On average, only 20-40% of a solar energy system's output ever goes into the grid, and this exported solar electricity serves nearby customers' loads.

Net metering (or net energy metering, NEM) is an electricity billing mechanism that allows consumers who generate some or all of their own electricity to use that electricity anytime, instead of when it is generated. This is particularly important with renewable energy sources like wind and solar, which are non-dispatchable (when not coupled to storage). Monthly net metering allows consumers to use solar power generated during the day at night, or wind from a windy day later in the month. Annual net metering rolls over a net kilowatt-hour (kWh) credit to the following month, allowing solar power that was generated in July to be used in December, or wind power from March in August.

Net metering policies can vary significantly by country and by state or province: if net metering is available, if and how long banked credits can be retained, and how much the credits are worth (retail/wholesale). Most net metering laws involve monthly rollover of kWh credits, a small monthly connection fee,[note 1] require a monthly payment of deficits (i.e. normal electric bill), and annual settlement of any residual credit. Net metering uses a single, bi-directional meter and can measure the current flowing in two directions.

Buildings-to-grid (B2G) integration:

Buildings-to-grid (B2G) integration refers to the interface of the commercial building sector with the electric grid. This integration helps to maintain electricity system reliability by enabling buildings to contribute to changes in electricity supply and/or demand. In India, the potential for this strategy to save energy and help ensure the smooth addition of renewable energy to the grid is particularly good, since two-thirds of the commercial building stock that is anticipated to exist in 2030 has not yet been built and the development of India's Smart Grid is in its early stages.

Opportunities for B2G Technologies in India Significant regulatory, policy, and promotional efforts in the area of Smart Grid and building energy efficiency, both at central and state governments have paved the way for B2G technology penetration in India. Such opportunities will be realized and further enhanced by the immense market opportunity created by proposed pilot. While Indian stakeholders and policy makers are learning quickly from relevant international activities, there are gaps in technologies. This must be addressed in order to meet the objectives of a Smart Grid roadmap and inform country-specific policies. The pilot technology deployment roadmap was developed based on the technological gaps identified and parallel efforts of Indian stakeholders. We noted that there is current lack of interfacing technologies such as BMS systems that are programmable and can communicate with loads and cloud-based servers for DR signals. There is a good potential for U.S. technologies to support the B2G enabling technology market in India, while necessary market transformation policies should be in place to motivate customer participation. New skills are required for characterization, technology upgrade, site-specific DR strategies development, implementation, and performance assessment, in addition to creation of new job opportunities in India. The pilots conducted will help to define these skill sets in the Indian context and in identifying the potentials and gaps in training of the Indian workforce for Smart Grid preparedness. The study suggests that the investment in the U.S. Smart Grid had a positive impact on the economy. For the $2.96 billion invested by the Government, the generated total economic output was at least $6.8 billion (Energy.gov 2013).

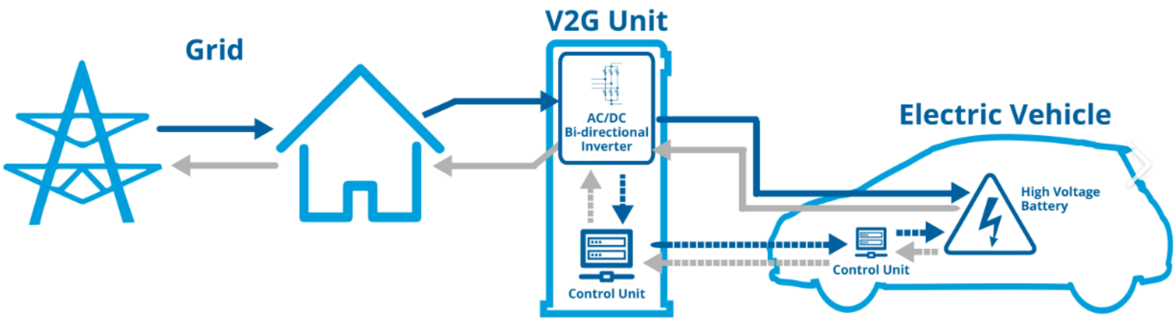
Demand Response and Energy Efficiency for B2G Integration To foster integrated demand response and energy-efficiency technology applications for building-to-grid integration, and to improve overall electricity system reliability, a contextual and integrated framework is needed for India. This integrated framework must assess both DSM and B2G requirements to interface with Smart Grid, and identify the requirements of communication standards and technologies, business, markets, and policy. This section outlines the integrated framework, which is based on building-to-grid and industry-to-grid activities in the United States. It is relevant to both the Indian scenario and the roadmap defined by the ISGF.

Vehicle-to-grid (**V2G**):

Vehicle-to-grid (**V2G**), also known as **Vehicle-to-home** (**V2H**) or **Vehicle-to-load** (**V2L**) describes a system in which plug-in electric vehicles (PEV) sell demand response services to the grid. Demand services are either delivering electricity or by reducing their charging rate. Demand services reduce pressure on the grid, which might otherwise experience disruption from load variations.

Plug-in electric vehicles include battery electric vehicles (BEV), plug-in hybrids (PHEV), and hydrogen vehicles. They share the ability to generate electricity. That electricity is typically used to power the vehicle. However, at any given time 95% of cars are parked, while their energy sits unused. V2G envisions sending some of the stored power to the grid (or reducing charge rates to pull less power from the grid). A 2015 report found that vehicle owners could receive significant payments.

Batteries have a finite number of charging cycles, as well as a shelf-life, therefore V2G can impact battery longevity. Battery capacity is a complex function of battery chemistry, charge/discharge rates, temperature, state of charge and age, and evolves with improving technology. Most studies using slow discharge rates show only a few percent of additional degradation while one study suggested that using vehicles for grid storage could improve longevity.



Time of the day pricing (TOD):

Time of Day (or TOD) tariff is a tariff structure in which different rates are applicable for use of electricity at different time of the day. It means that cost of using 1 unit of electricity will be different in mornings, noon, evenings and nights. This means that using appliances during certain time of the day will be cheaper than using them during other times.

Electricity grids can be compared to road or highway that can accommodate only a certain number of vehicles at a time. During peak hours highways are jammed, similarly during peak hours, electricity grids are jammed. Drive on highway during off peak hours is like a breeze, similarly flow of electricity during off peak hours is a breeze. What if people are charged differently for using highways during different times and also charged as per size of their vehicles. People with either prefer to go through highway at a time when traffic is less (off peak) or would like to use a two-wheeler. Similaly, with TOD tariff, people will either switch to a time when prices are less or will start using efficient appliances (with lesser electricity consumption).

Electricity consumption is increasing drastically and the production is not growing up at that pace. Shortage of fuel (coal) adds to the problem. To make sure that there is sufficient supply for the demand, utilities have to make sure that they help their customers manage their power consumption. It is not that they reduce their profits by helping customers reducing consumption, but they do this to make sure that they are able to supply electricity to all customers as per their demands. Problem that utilities face is of peak power demand. There are certain times in the day when the demand for electricity is at its peak. During these times, utilities have to purchase power at very high cost, much higher than the price paid by consumers. To reduce the peak power demands there are two options: Either they reduce the power demand at the peak hours or overall reduction in power demand.

Time of Day tariff is implemented to reduce consumption of electricity during peak hours. To do this, electricity is made expensive during peak hours so that consumers use less of it.

Utilities also reduce the electricity charges during off peak hours as an incentive for people to use electricity during the off peak hours.

Time of use pricing (TOU):

Time-of-use (ToU) pricing is **widely used by the electricity utility to shave peak load**. Such a pricing scheme provides users with incentives to invest in behind-the-meter energy storage and to shift peak load towards low-price intervals.

A large portion of the population is away from home during typical work and school hours—and that's why less energy is consumed in most homes throughout much of the day. During the mornings and evenings, however, the demand for energy grows. This is when the majority of us are at home, using our electronic devices, turning on the lights, and adjusting the thermostat for more comfortable temperatures. These times of day when a region's energy load is highest are referred to as "peak" energy hours.

Time-of-Use Rate Plans

Traditional utility prices involve a set rate per kilowatt-hour, which can fluctuate during the summer and winter. A sliding rate scale, however, is structured according to peak and off-peak times of day. This is called a "time-of-use" (TOU) rate plan. Under such a plan, your bill will be determined by how much energy you use *and* when you use it.

The prices and peak times vary based on the season and day of the week; for example, many utility companies consider weekends off-peak. The structure often looks different in the summer or winter months, with more tiers to accommodate the increase in HVAC system use as everyone tries to cool off or stay warm.

Consumer privacy and data protection:

The Consumer Privacy Protection Act would authorize the Personal Information and Data Protection Tribunal to impose an administrative monetary penalty on an organization that has contravened the Act. It would also create new offences for re-identifying personal information that has been de-identified, subject to an exception for security testing, and contravening an order issued by the Privacy Commissioner following an inquiry.

Smart grid technologies have the capacity to create tremendous new value for electricity consumers: from advanced IT and communication technologies that improve the overall operation of our nation's electricity transmission and distribution networks; to smart meters and digital sensors that help utilities quickly identify and minimize the extent of outages when they do occur. In addition, consumers now have the ability to monitor and manage their electricity use in far greater detail by tapping into the data generated by smart meters.

Many of these emerging technologies—which provide tremendous benefits not only for the nation's electric system but for consumers throughout the United States—will result in an increase in the amount of data collected regarding grid operating characteristics, including customer energy use data. As the nation's electric infrastructure is modernized, it is critically important to ensure that the collection of data is performed in a manner that yields the greatest benefits for consumers, while continuing to rigorously protect their privacy.

Smart grid enhances the power grid with information and communication technologies, such as control systems, network communication, and computation facilities, to enable two-way exchange of electricity and information between operation centers and smart meters, while making the grid more reliable, efficient, secure and greener. In smart grid, operation centers are allowed to collect and analyze real-time power consumption and local energy generation for distribution management, outage identification, state estimation and dynamic billing. The operation centers share electricity consumption to power plants, thereby help power plants to adjust energy production and reduce the demand to fire up costly and secondary power plans [2]. Not only could the customers access real-time usage data and electricity prices, but also decrease their energy consumption by shifting the uninterrupted activities from peak time to non-peak time.