Smart FiT

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This note presents the concept of a modified Feed-in-Tariff (FiT) referred to as ***Smart FiT***. This modification aims to take the best elements of the most effective solar energy compensation system to date, but removes some its weaknesses. In particular, the proposed Smart FiT links the tariff to value produced and includes long-term market controls leading to very high penetration.

INCENTIVES

PV still appears to be expensive when compared without context to traditional power generation despite immense progress over the last few years. Constituents, however, generally believe that solar energy delivers a higher value than can be monetized in a business as usual setting -- the values that are often unaccounted for include environmental value, fuel depletion and price mitigation value, market price reduction, economic development, jobs, energy security, and value linked to displacing conventional resources' embedded incentives (e.g., see Figure 1). This understanding is the reason why cities, states, provinces and countries around the world have developed financial transfer mechanisms in an attempt to level the playing field and make up for the part of the value delivered by solar generators that is not currently monetized. These financial transfer mechanisms are typically referred to as "***incentives***." However, as will be shown below, the term incentive does not have to imply the notion of subsidy.

Incentives/ financial transfer mechanisms have taken many shapes and forms including buy-down grants, Solar Renewable Energy Credits (SRECs), reverse auctions, net-metering, feed-in-tariffs (FiTs) as well as income tax credits (ITC), tax abatements, tax exemptions, low-cost financing, etc. (e.g., see Dsire, 2012) which can either be tax-financed and/or utility ratepayer-financed. In the US, the ratepayer-based transfers of value are generally driven by Renewable Portfolio Standards (RPS) whereby a renewable deployment goal is specified by the law and implemented by forcing utilities and grid operators to purchase renewable energy credits from renewable energy producers.

FiT

As described in Wikipedia (2012), "a feed-in-tariff is a policy mechanism designed to accelerate investment in renewable energy technologies. It achieves this by offering long-term contracts to renewable energy producers, typically ***based on the cost of generation of each technology***. Technologies such as wind power, for instance, are awarded a lower per-kWh price, while technologies such as PV are offered a higher price, because of their higher costs."

FiTs have been very successful financial transfer mechanisms as gauged by the amount of renewable energy deployed: as of 2010, 80% of the PV resource was deployed world-wide under a FiT market mechanism (Couture et al., 2010).

This success is a direct result of three key attributes: (1) administrative simplicity, (2) contracted long term revenue guaranty, and (3) simplicity of PV-grid interconnection.

However several of the world's FiT programs have been victims of their own success. For example, the Spanish program has had difficulties because of an absence of adequate market controls, long-term planning and program flexibility. In Spain, the one-size-fits-all/no-limit FiT resulted in very large systems with large economies of scale rapidly flooding the market and, in effect, killing the program. In addition, because FiTs are cost-based incentives, many question the rationale of preferentially subsidizing the most expensive technologies. FiT adjustments following cost reductions are often done by ad hoc steps, often taken on an emergency basis, leading to market rushes and slow downs. Although the German program has been the most successful in terms of market growth, it has not been immune to these flaws and has reached near crisis status more than once.

Smart FiT

A Smart FiT retains the key attributes that have contributed to the FiT success: simplicity of interconnection, minimal administrative work, predictable bankable long term per kWh contracts. A Smart FiT, however, differs from a traditional FiT in several fundamental ways:

- It is value-driven.
- There are market throttle controls.
- The long-term end game is controlled.

- **Value-Driven:** The Smart FiT is value-driven rather than cost-driven and thus addresses the underlying reason for incentives in the first place: to capture the renewable value that cannot be fully monetized under business as usual conditions. The argument is that ***investors should be fairly compensated for the value that they produce***. In the case of PV, this value is multifaceted (Figure 1) and influenced by four factors:
    1. The location of PV within the transmission and distribution networks;
    2. The local penetration of PV;
    3. The placement (orientation/tilt) of PV and
    4. The availability or not of emergency/dispatchable storage capability

  These factors determine:

1. The ability of PV to actively support the transmission and distribution grids by reducing peak demand stress;
2. The environmental value resulting from the locally displaced energy mix;
3. The operational and infrastructural T&D measures that will be necessary to absorb a growing amount of solar generation; and
4. The ability of installations to mitigate the consequences of power outages and natural disasters[1] at an individual or at a community level.

The Smart FiT should reflect these factors in an intelligent per kWh price that would depend upon location and system specs, and self-adjust over time as penetration increases.

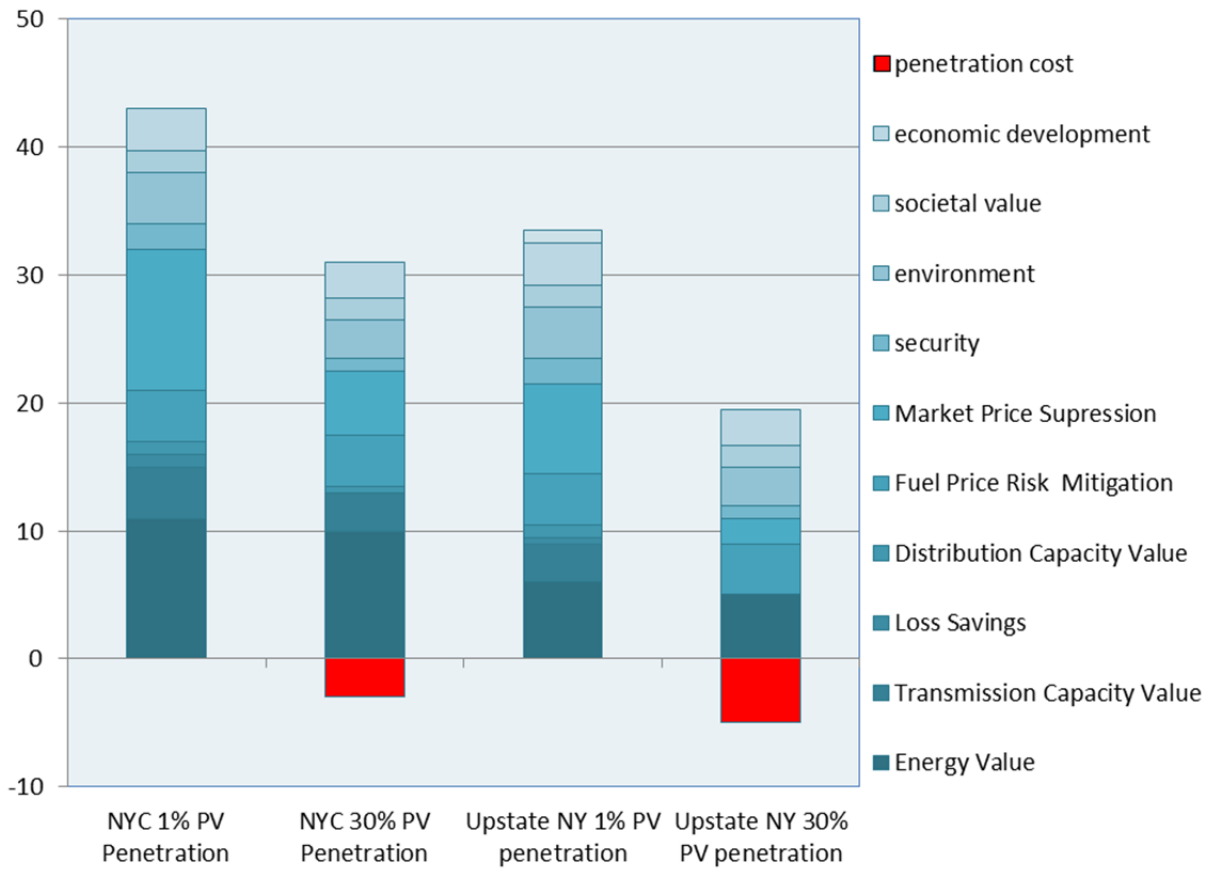

FIGURE 1 – Example of value delivered by PV generation in the New York City (NYC) metropolitan area and in upstate New York at 1% and 30% PV penetration (source Perez et al., 2011, CPR, 2012). This example is shown for PV systems without emergency storage/outage recovery capability.

[1] A non-negligible part of Hurricane Sandy's toll in New York and New Jersey was the lack of electrical power that impeded disaster recovery, and kept people in the cold and without access to basic necessities such as gasoline for their generators and cars. There is ample evidence (including one of the author's own experience) that PV systems equipped with a small storage system can power emergency loads indefinitely and thereby keep homes and business up and running and even provide community relief (e.g., gas stations equipped with such systems).

- **Market Throttle Controls:** The examples of Spain, and more recently New Jersey have demonstrated that an incentive that is too generous can result in overbuilding, exceeding mandates and planners' expectations. This has resulted in the effective end of a thriving solar market in Spain and a drastic reduction in the value of the solar renewable energy credits in New Jersey. Therefore, PV value should inform the Smart FiT but not set its worth directly, at least not in cases where value would be much higher than current local system cost. Ideally the Smart FiT should be set at the minimum between a system's levelized cost of energy (LCOE) with an acceptable ROI and levelized delivered value and illustrated in Figure 2.

  Real-time" throttle control" FiT adjustments for new systems should also be built-in by monitoring the rate of installations and adjusting current new FiTs down gradually if the rate exceeds the planned rate, or up if it is insufficient, but without exceeding value.

  Other existing incentives: The value-derived Smart FiT should account for other sources of revenue. The full value should be considered when the FiT is the only value transfer mechanism available. The Smart FiT should be reduced commensurably by the value of other incentives (e.g., Federal ITC, State ITC, buy-down, and net-metering, as in New York State) when they exist as illustrated in the bottom of Figure 2.

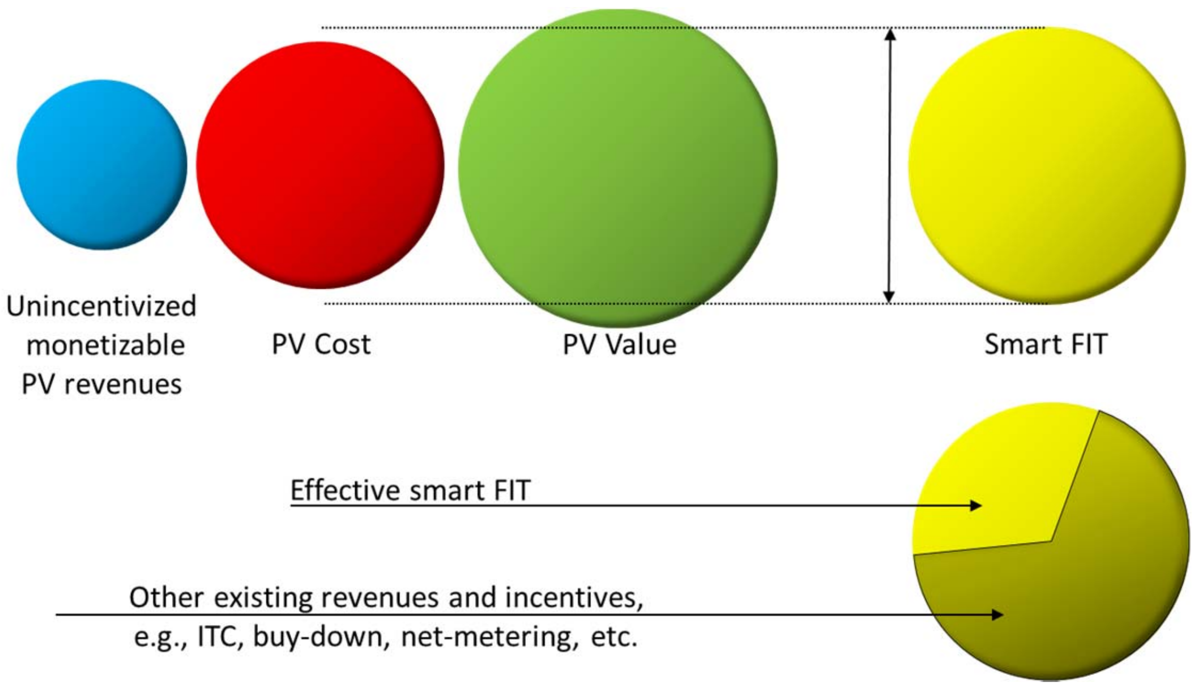

Figure 2 – Positioning the Smart FiT: unsubsidized business-as-usual revenues from PV (blue circle) are often less than the cost of deploying the technology (red circle). The value to the tax payers and ratepayers (green circle) may be considerably higher. The Smart Fit (yellow circle) is a transfer mechanism that would most effectively be positioned between the value generated by PV and its cost. The Smart FIT would have to be reduced commensurably in cases where other revenue streams exist (bottom right).

- **Controlled long-term end game:** The Smart FiT should be designed to gradually decline over time because value decreases and integration costs increase as resource penetration increases. However, unlike sudden market price reactive changes affecting traditional FiTs, collapses affecting RECs, and threats of discontinuity affecting ITCs, the Smart FiT decline would be predictable and programmed from the onset to reflect planned PV penetration and the associated loss of value and increase in integration costs. This decline, occurring in parallel with expected PV price declines, would be designed to transition to a long-term very high-penetration equilibrium between value generated and the cost of the infrastructural enablers of high penetration PV including: load management, storage, solar/wind synergy, solar/gas synergy (initially), and long-distance interconnection. Figure 3 represents a hypothetical example of long-term high-penetration plan for New York metropolitan area.

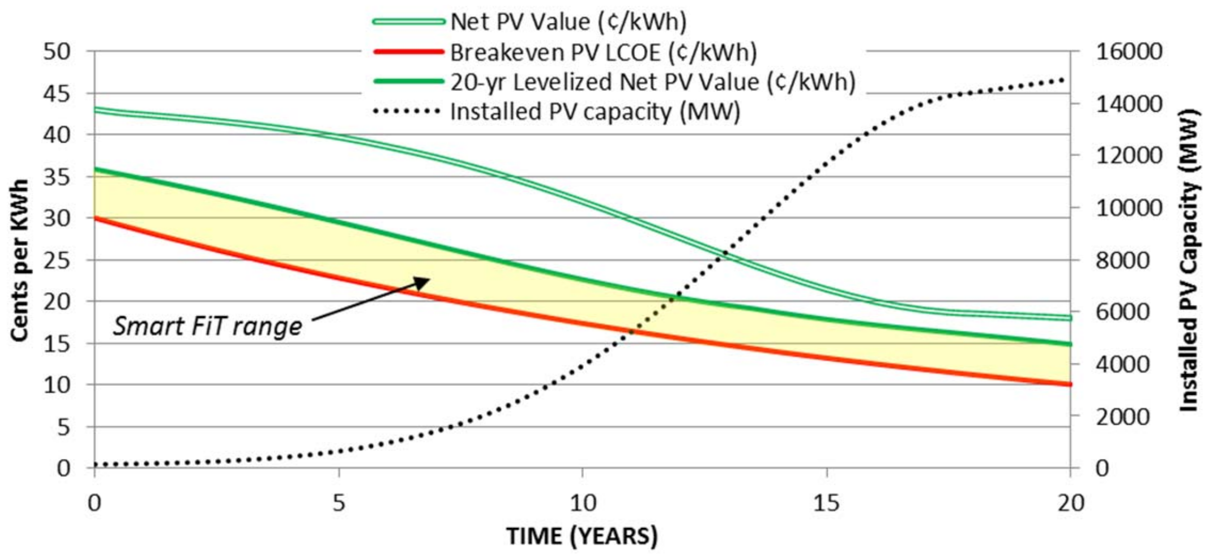

FIGURE 3: The net PV value (double green line) decreases over time as planned PV penetration increases in the New York metro area (black dotted line). The dotted green line is the 20-year levelized net PV value (derived from the green line) and would represents the 20-year Smart FiT contract's upper bound acceptable to the constituency at any point in time. The PV system's unsubsidized 20-year levelized cost (red line) represents the Smart FiT contract's lower bound acceptable to investors.

Not a subsidy: It is important to point out that the Smart FiT is not a subsidy. This is because it is designed to be less than delivered value. As penetration increases the value will naturally reflect penetration cost and should be low enough to not even be perceived as an incentive by detractors.

What if cost exceeds value: the likelihood of justifiable value being below PV cost in most of the US is small today and will likely be in the future. For instance in the New York metro region at $4.5/W turnkey (certainly achievable today) it takes about 30 cents per kWh in the absence of any incentive to generate a 30-year 7% return on investment (ROI). This is well below the levelized value delivered by PV for the region, conservatively estimated at well over 35 cents per kWh (CPR 2012, Perez et al., 2011). Using the DOE Sunshot's objective of $1/W turnkey as a gauge for the very high penetration future (USDOE, 2012), it will take 8 cents/kWh to produce a 7% ROI in the considered region. Although the solutions that will enable high penetration are only being conceived at this time, it is unlikely that their cost will bring the total value delivered by PV below this level.

- **Very Smart:** Of course a Smart FiT should include and embrace common sense and effective attributes that have been successfully pioneered elsewhere such as community solar gardens (e.g., see McCabe, 2012) and virtual system ownership (e.g., see California PUC, 2012). This will: (1) enable every energy producer large and small to participate and not only those in high value, high yield locations (e.g., a prospective producer with a shaded roof in a low value area could take part in an unobstructed, high value system); and (2) enhance high-value deployment without penalizing prospective investors in low value locations. In essence, the Smart FiT would use market forces to channel PV development to those areas of the grid that need PV support.

Who would pay for the Smart FiT? PV deployment value and costs accrue to two parties: ratepayers and taxpayers. Although these two parties are often the same, it would be practical to retain this distinction in the cash sources of a Smart FiT program. Such a program would be most effectively handled by utilities with the ratepayer-traceable part of the Smart FiT originating from a specific rate surcharge and the taxpayer part originating from the taxing authorities – for instance, credited back to the utility through periodic governments contributions.

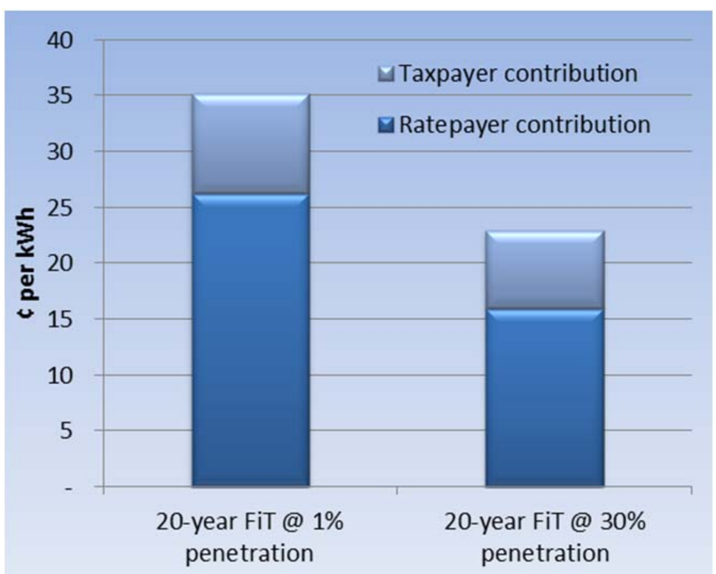

FIGURE 4: Cash sources of Smart FiT payment at 1% and 30% capacity penetration based upon the [hypothetical] data presented in figure 1 and figure 3

CHALLENGES

There are several challenges in implementing a Smart FiT. More specifically, a Smart FiT requires:

1. A shared understanding of the net value created by PV generation as a function of location, resource penetration and system specs. This will involve the collaboration of utilities to identify how the physical value and costs of integrating solar varies throughout their networks (as a function of e.g., load shape and customer mix, expected load growth, generation mix, outage risk, etc.);
2. An adjustable long-term plan for local solar resource growth leading to high penetration, so as to inform the evolution of Smart- FiT value over time and bring certainty to long term contracts;
3. Real time monitoring of PV deployment rate so as to efficiently operate market throttle controls if needed;
4. A shared understanding of the infrastructural solutions to very high solar penetration, and of their cost, as these solutions (*many of which may not have been invented yet*) develop over time.

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