D2.5
Implementation policies for architectural PV

ETFE-MFM

Development and demonstration of flexible multifunctional ETFE module for architectural façade lighting

<table>
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<th>Contract number</th>
<th>322459</th>
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<tr>
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<td>Duration</td>
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## ETFE-MFM deliverable fact sheet

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<td>2 (ACC)</td>
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<td>ACC</td>
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<td><strong>CO = Confidential, only for members of the consortium (including the EC)</strong></td>
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Summary

This document contains information related to the Implementation Policies for Architectural PV in Europe and rest of the world, with special interest in those countries which are supposed to be the natural market for ETFE-MFM element in coming years.

These key countries have been identified by crossing information from global construction growth perspectives, world economic growth forecast and global photovoltaic market prospect outlook for next decades.

Additionally, an analysis for post-incentive era for building integrated PV generation has been carried out (self-consumption, grid parity, “prosumer”) in order to plot out what the future for PV ETFE-MFM element will be, once emerging PV markets will become mature scenarios.

Considering ETFE-MFE element as a PV module rather than a construction element will benefit this product with the multiple existing support schemes to so called rooftop PV deployed all around the world.
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Introduction

The integration of solar photovoltaic technology in buildings is considered by many authors the most promising application of this technology. Its relative youth, coupled with the problems associated with the integration in a remarkably complex (and usually conservative) sector such as construction, makes incentive policies essential tools to ensure the incorporation of photovoltaic technology in buildings.

In recent years, these incentive policies have been the fuel of PV integration in buildings, providing the necessary stimulus at a time when prices of photovoltaic installations were far from competitive. With the drastic reduction in prices of photovoltaic systems during the last five years, especially in mature markets, these support schemes have been readjusted, reduced or even eliminated in some countries\(^1\),\(^2\).

This deliverable analyses the current state of these incentives on potential markets for the ETFE-MFM product, along with the evolution of PV support schemes and the influence of past support policies in the PV building integration.

The report concludes that both the prospects for strongest world growth in the construction industry, the perspectives for global economic growth and the outlook for PV market will simultaneously happen in a bunch of countries or regions different of those of the OECD. And these countries, in general, are about to initiate incentive policies for PV vast deployment, in the way it was done so successfully in industrialized countries from Europe, US / Canada, Japan and Australia during the past decade.

One important conclusion is the possibility for ETFE-MFM element to be awarded with these incentives if considered a photovoltaic element, with additional prerogatives available for BIPV-systems in a few countries, in addition to the standard feed-in tariff/net metering, rebates or grants. Initially, ETFE-MFM product is been ideated just to cover the power demand of the LED lighting array. Nevertheless, not only an off-grid system with batteries is possible for a façade built with ETFE-MFM modules: power consumption and injection into the grid would be viable if supply shortage or over-production, respectively, exists and the local administration allows the net connection. It would be indispensable indeed in absence of batteries, since an auxiliary electrical system would be necessary in order to guaranty power supply. In this regard, it is convenient to know the different policies of incentives and taxes, depending of the modality of the grid connection and BIPV legalization.

PV support schemes have shown in the past a never ending evolution nature. Thus, the information provided in this document will be updated at the end of the project with the deliverable D2.7 (*Implementation Review for Policies for architectural PV - regional, EU and ROW*) in month 42, when the ETFE-MFM element is supposed to be ready for market.

\(^1\) http://www.res-legal.eu/search-by-country
\(^2\) http://www.reegle.info/policy-and-regulatory-overviews
1 Methodology

Since in some countries the different level of architectural/structural integration of the photovoltaic element is granted progressively, the nature of the ETFE-MFM element is redefined and classified in terms of its level of integration (BIPV or BAPV) in the building.

Next, we analyse the LCoE (Levelized Cost of Energy) for a photovoltaic installation. This figure allows to compare different PV installations from an energy-economical point of view (€/kWh), (i.e., the profitability of photovoltaic generation over local electricity price-retail price) in different locations. This input becomes very interesting for the PV element, being the base cost of PV generation compared to grid retail cost. Incentives mechanisms to PV will be added to LCoE, accelerating the grid parity (i.e. when an alternative energy source generates electricity at a cost matching the price of power from the electric grid), or even surpasses it.

Subsequently, an exhaustive description of the diverse existing mechanisms as PV deployment policy support is carried out.

Then, some fundamental concepts in photovoltaic integration are analysed, new concepts appearing as the natural evolution schemes in post era incentives, happened in mature countries: self-consumption, (mechanism that has enhanced the integration of photovoltaic in the building), by which some countries allow the use of PV generated in the building itself, and export to the grid the surplus with compensation (net metering, net billing), etc.

Being the ETFE-MFM element considered as a photovoltaic device, and so positively affected by PV support schemes, the identification of regions/countries where photovoltaic ETFE-MFM shows a brilliant implantation future is done. For that, a crossing data analysis from growth perspectives to construction industry in the world, outlook for global economic growth and the global growth prospect for the photovoltaic market has been carried out. A bunch of countries targeted as key countries for ETFE-MFM element is proposed.

For such target countries the existing policies and mechanisms to encourage photovoltaic in building, financing tools, etc., has been analysed. This study will provide a very close scenario to geographical potential market for ETFE-MFM as a PV element in the coming years.

This report ends by proposing some measures to encourage incentive mechanism which will accelerate ETFE-MFM PV element in buildings, in those markets with a greater potential to photovoltaic building integration.
2 ETFE-MFM element: BIPV or BAPV

2.1 Additional incentives for BIPV systems

A few countries have proposed different incentive tools for photovoltaic depending on the degree of architectural integration at a building. For instance, the new format of the U.S. investment tax credit and Europe’s new Energy Performance of Buildings Directive are policy tools that have served to accelerate BIPV penetration.

Therefore, it is important to answer at this point of the project at which integration category the ETFE-MFM element belongs to, and how this classification will be affected by more or less favourable policy incentives.

PV modules can be applied into the building envelope in several forms. Depending on their level of integration and on the functionalities they can perform, they are classified into:

- **BAPV is Building Applied PV** — it’s a retrofit added to the building long after construction, while BIPV is Building Integrated PV, which means that the architects, building designers, building owners designed, etc., integrate the photovoltaic into the skin and roof of the building from day one. BAPV (Building Adopted/Applied Photovoltaic) refers to concepts where the photovoltaic systems are mounted on top/ façade of the building existing structure and therefore do not add any additional value beside thus of producing electricity. BAPV is normally added to the building after the process of construction is finished.

  ![Fig. 1. BAPV installation rooftop](image)

- **BIPV is Building Integrated Photovoltaic** \(^1\)-it signifies that photovoltaic elements have been present in the project from the very beginning – as a part of a holistic design. Thus, for the BIPV, solar modules have the role of a building element in addition to the function of producing electricity.

  Essentially, Building Integrated Photovoltaic (BIPV) refers to photovoltaic cells and modules which can be integrated into the building envelope as part of the building structure, and therefore can replace conventional building materials. BIPV modules can be naturally blended into the design of the building. It can be used in any external building surface.

  Existing BIPV products are able to fully replace some building components - the construction parts of

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\(^1\) SEAC - BIPV REPORT 2013 State of the art in Building Integrated Photovoltaics
the building envelope (roofing, façade cladding, glass surfaces), sun protection (sunscreen), architectural elements and accessories "(porches, balconies, railings, etc.) or for instance, elements of visual and acoustic shielding. Within the BIPV definition, also plants integrated in urban and transport structures (independent shelters, shelters for vehicles, sports or play, bus stops, etc.) are considered. The large variety and different characteristics of the available BIPV products makes it possible for them to fully replace many of the building components, mainly in façades and roofs (building envelope).

The building envelope guarantees a border between the controlled inner building environment and the outer climate. It has to provide a stable air-quality, preventing the uncontrolled air mass exchange and enabling the appropriate functioning and efficiency of the air-conditioning systems. Moreover it is bound to be waterproof and fulfill the priority of ensuring the comfortable inner-climate with the possibly least energy expense. Thus, façades and roofs takes over a regulation and control functions in relation to the daylight, ventilation, energy, safety, demarcation and privacy protection, etc.

Thus, BIPV is defined as a multifunctional building technology element. Besides of being a source of electricity, several other purposes can be achieved, such as weather protection, thermal insulation, noise protection or modulation of daylight (they can be used to regulate the intake of daylight to a building by powering an automatic sun-blind, operate an engine driven ventilation opening or even as emergency lighting). Furthermore, they act as a public demonstration of a building owner’s green ecological and future-oriented image.

Additionally, other requirements (from the aesthetics as well as from the pure construction point of view) are to be met. Those are for instance:

- Colour, appearance, size.
- Weather-tightness.
- Wind and snow load.
- Resistance and maintenance.
- Safety in the construction and utilization phases (fire, electricity and mechanical safety).
- Costs.
- Weight and materials used.
**BIPV Fastening Systems** refers to those systems which allow the building integration of the most PV modules currently available on the market (standards modules often without frame). While being able to fulfill the need of the building envelope, they present one of the most competitive solutions since they can be produced at large scale in the factory thus reducing its cost. Their installation can also be easier since most PV installers will be familiarized with their mechanical and electrical characteristics. This type of solution is mostly applied into pitch roofs and external building walls as cladding element.

Despite the undoubted specificity of ETFE-MFM constructive element, and according to the above definitions, we can neatly classify and justify this element within the **BIPV & BIPV Fastening Systems** category. And this is important since in some countries additional incentives are available for BIPV-systems in addition to the standard feed-in tariff/net metering, rebates and grants.

The European BIPV market has grown rapidly due to countries like France and Italy which provide added incentives to consumers to adopt this technology in their homes. Smaller markets like the United Kingdom and Alpine countries are also poised to grow due to the special tariffs available for BIPV. The future offers good prospects for BIPV, and some legislative incentives continue in Japan, China, US, etc.

In next sections below two examples of these successful specific incentives to BIPV are analysed.
2.2 France

France entered the market of photovoltaic systems connected to the network later than other European countries, was the first to set specific rates for different degrees photovoltaic BIPV and specific eligibility criteria for each case. This, France aimed to encourage the PV industry specialization in components for architectural integration overlooking the domestic market and for export⁴.

<table>
<thead>
<tr>
<th>Location PV installation</th>
<th>Type of BIPV installation</th>
<th>Installed total capacity of PV installation</th>
<th>Feed-in-tariff (c€/kWh)</th>
<th>Proportion of electricity produced receiving FIT</th>
<th>Average FIT (c€/kWh) for produced electricity</th>
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<tbody>
<tr>
<td>Residential Buildings</td>
<td>Complete (IAB)</td>
<td>0 kW - 9 kW</td>
<td>31.59</td>
<td>100%</td>
<td>31.59</td>
</tr>
<tr>
<td></td>
<td>Complete (IAB)</td>
<td>9 kW - 36 kW</td>
<td>27.64</td>
<td>100%</td>
<td>27.64</td>
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<tr>
<td>Buildings for education and health care</td>
<td>Complete (IAB)</td>
<td>0 kW - 9 kW</td>
<td>21.43</td>
<td>100%</td>
<td>21.43</td>
</tr>
<tr>
<td></td>
<td>Complete (IAB)</td>
<td>9 kW - 36 kW</td>
<td>21.43</td>
<td>100%</td>
<td>21.43</td>
</tr>
<tr>
<td>Other buildings</td>
<td>Complete (IAB)</td>
<td>0 kW - 9 kW</td>
<td>18.58</td>
<td>100%</td>
<td>18.58</td>
</tr>
<tr>
<td>All building types</td>
<td>Simplified (ISB)</td>
<td>0 kW - 9 kW</td>
<td>18.17</td>
<td>100%</td>
<td>18.17</td>
</tr>
<tr>
<td></td>
<td>Simplified (ISB)</td>
<td>9 kW - 36 kW</td>
<td>17.27</td>
<td>100%</td>
<td>17.27</td>
</tr>
<tr>
<td>All installations types</td>
<td>No building integration &amp; all above maximum integration capacity</td>
<td>0 MW - 12 MW</td>
<td>8.12</td>
<td>100%</td>
<td>8.18</td>
</tr>
</tbody>
</table>

Table 1. Overview of FiTs for photovoltaic generated electricity in France (01.10.2012-31.03.2013), sorted by installed capacity, location of installation and type of BIPV

An additional FIT bonus of 10% or 5% is available for components made in Europe meeting IAB or ISB criteria in installations with a maximum capacity of less than 100 kW.

2.3 Italy

Italy is another country that has established rates photovoltaic "feed-in-premium" type which incentives in a special way the architectural building integration defined for specific integration requirements. These rates also may increase in combination with performance and energy efficiency savings held in buildings. In mid-2005 was created the first tariff for PV technology, called "Conto energy", (which was amended on 2 occasions), under which 120 MWp were installed. In 2007 the incentive rates are modified and type FIP ("feed-in-premium") and application conditions were introduced. The main features of the second version of "Conto energy" are:

Set different rates for basic facilities considered "full architectural integration", "partial architectural integration" and not included (the rest) and sizes. Facilities whose owners are local governments are considered all architecturally integrated, regardless of their characteristics effects.

- Basic rates may be increased by 5% in the following cases:
  - Facilities larger than 3 kWp power and not integrated, which owners are considered “self-producers” (consume at least 70% of electricity production).
- Recognizes an added value to the electrical output of the PV system, which may:
  - Selling out all or part of the network (direct sales or indirect electrical market through System Operator ("Gestore dei Servizi Elettici" GSE).
  - Be used locally (self);
  - Avail oneself of an assessment of the type "net-metering" (for systems up to 200 kW only). Is to assess the injected electricity into the network according to a criterion of compensation that takes into account the price of electricity consumed (purchased) network. The result will be, if photovoltaic net surplus "credit" for the owner of the PV system that will allow negative balances offset future. The applicable price is an average of the prices of regional supply.

- The above basic rates may be increased by a maximum of 30% through the combination with energy efficiency measures:
  - In new buildings, if the primary energy consumed for heating is less than 50% of the standard levels set by law.
  - In existing and refurbished buildings, when the reform results in a reduction of at least 10% of energy consumption for heating and domestic hot water.

In both cases, the owners of PV systems must choose the mode of valuation "net-metering".

- The requirements for photovoltaic systems to be considered "architectural integration" or "added to buildings" are collected in a BIPV Guide published and updated by the GSE []:
  - "Full architectural integration" is considered when the PV modules completely replace all or part of the envelope (roof, films or metal covers) and thus play a dual role (eg, waterproofing, protection and thermal control to noise reduction, etc.). 10 Specific types are distinguished:

1. Replacement of roofing, roofs and facades with photovoltaic modules with the same inclination and architectural functionality that replaced the coated surface.
2. PV modules integrated protection structures, pergolas and awnings.
3. Partial substitution of transparent covers (glass, plastic, polycarbonate, etc.) of buildings with photovoltaic modules that allow natural lighting of one or more interior spaces.
4. Photovoltaic modules integrated into anti-noise barriers.
5. Photovoltaic modules integrated into elements of lighting and street furniture for advertisements, news items, parking meters, etc.
6. Photovoltaic modules in which the shading elements shading elements are the modules themselves and the associated support structure.
7. PV modules integrated in balustrades and parapets replaces conventional cladding elements and coverage.
8. PV modules that replace all or part surfaces glazed windows.
9. PV modules integrated blinds (modules must constitute the structural elements thereof). Photovoltaic modules 10 integrated as a coating or covering of buildings adhered to the coated surface (including flexible thin layer modules).

  - "partial architectural integration" the following types are considered:
    - 1 installed photovoltaic modules on flat roofs and terraces.
Photovoltaic modules are installed on roofs, walls, balustrades, or parapets coplanar to the support surface so (no substitution of materials constituting the bearing surface thereof).

3 PV modules installed on street furniture, sound barriers, guards, pergolas and awnings coplanar to the support surface so (no substitution of materials from which the supporting surface itself).

The document also includes examples of facilities that will not be considered architectural (total or partial) integration because:

- Failure connecting elements covering the horizontal or vertical discontinuity between the photovoltaic modules, which may affect the waterproofing or thermal properties of the roof.
- Non-adaptation of the PV modules to the geometry of the roof.
- Photovoltaic modules that extend beyond the perimeter of the deck.
- Photovoltaic modules whose thickness exceed the upper bound of the tiles surrounding land.

### Table 3. FIT for BIPV elements as conceived in Italy before July 5, 2013

<table>
<thead>
<tr>
<th>Power (kWp) P</th>
<th>Total architectural integration c€ / kWh</th>
<th>Partial architectural integration c€ / kWh</th>
<th>Non-integrated c€ / kWh</th>
</tr>
</thead>
<tbody>
<tr>
<td>1≤P≤3</td>
<td>47.00</td>
<td>42.20</td>
<td>38.40</td>
</tr>
<tr>
<td>3 &lt; p≤20</td>
<td>44.20</td>
<td>40.40</td>
<td>36.40</td>
</tr>
<tr>
<td>P &gt; 20</td>
<td>42.20</td>
<td>38.40</td>
<td>34.60</td>
</tr>
</tbody>
</table>

Notes: Rates guaranteed 20 years.

As of July 5, 2013, Italy ceased offering FiT payments because its €6.7 billion cap was reached 30 days prior on June 6. The FIT immediately prior to cancellation is shown below.

The Italian feed-in tariff scheme digresses every six months. It last digressed on February 27, 2013 and is next set to digress on August 27, 2013.

### Table 4. Overview of standard FiTs for photovoltaic generated electricity in Italy

<table>
<thead>
<tr>
<th>Rooftop/BIPV</th>
<th>Ground-mounted</th>
<th>Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size</td>
<td>Incentive</td>
<td>Size</td>
</tr>
<tr>
<td>1-3kW</td>
<td>0.182€/kWh</td>
<td>1-3kW</td>
</tr>
<tr>
<td>3-20kW</td>
<td>0.171€/kWh</td>
<td>3-20kW</td>
</tr>
<tr>
<td>20-200kW</td>
<td>0.157€/kWh</td>
<td>20-200kW</td>
</tr>
<tr>
<td>200kW-1MW</td>
<td>0.130€/kWh</td>
<td>200kW-1MW</td>
</tr>
<tr>
<td>1MW-5MW</td>
<td>0.118€/kWh</td>
<td>1MW-5MW</td>
</tr>
<tr>
<td>5MW+</td>
<td>0.112€/kWh</td>
<td>5MW+</td>
</tr>
</tbody>
</table>
The feed-in premiums in the table are further increased by the following increments:

- €0.02/kWh for plants using modules and inverters that were produced in the European Union or European Economic Area if they enter into operation on or before 31 December 2013; €0.01/kWh if they enter into operation on or before 31 December 2014; and €0.005/kWh if they enter into operation after 31 December 2014.

- €0.03/kWh for plants up to 20 kW nominal power installed on rooftops with simultaneous complete removal of asbestos and €0.02/kWh for plants above 20 kW nominal power if they enter into operation on or before 31 December 2013; €0.02/kWh up to 20 kW nominal power and €0.01/kWh above 20 kW nominal power if they enter into operation on or before 31 December 2014; and €0.01/kWh up to 20 kW nominal power and €0.005/kWh above 20 kW nominal power if they enter into operation after 31 December 2014.
3 LCoE. Retail prices & Grid Parity

Incentive policies for PV integration have been proven to be an essential mechanism to achieve grid parity in many countries, becoming a temporary economic support as the price of photovoltaic installations dropped down till reaching local grid parity (retail grid prices).

Grid parity occurs when PV energy installation can generate electricity at a levelized cost of Energy (LCoE) that is less than or equal to the price of purchasing power from the electricity grid. Reaching grid parity is considered to be the point at which an energy source becomes a contender for widespread development without subsidies or government support. It is widely believed that a wholesale shift in generation to these forms of energy will take place when they reach grid parity.

As the price of solar components has dropped down in the last five years, LCoE has dropped down consequently, and grid parity has been reached in some countries recently. In some others, grid parity has been reached still with the help from government subsidies.

3.1 Calculation of PV LCoE

As of 2013, the cost per MWh of rooftop solar was below retail electricity prices in several countries, including Australia, Brazil, Denmark, Germany, and Italy. By one estimate, solar PV is deemed to be competitive without subsidies in at least 19 markets (in 15 countries). Further, several project that were planned or under development by years end were considered to be competitive with fossil options, without subsidies.

The purpose of this chapter is to analyse the PV grid parity (also applied to ETFE-MFM element) in different world regions through its LCoE. Thus, the cost of generating PV electricity is compared against the cost of electricity from the grid, assuming 100% PV self-consumption. This cost is represented by the PV LCoE which is defined as the:

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6. Photovoltaic Grid Parity Monitor. Leonardo Energy By David Perez 29/05/2014
constant and theoretical cost of generating one kWh of PV electricity, whose present value is equal to that of all the costs associated with the PV system over its lifespan.

As such, it includes all relevant costs that influence the decision of whether to self-consume PV electricity or to buy it from the utility.

As a matter of fact, in the case of ETFE-MFM elements some other considerations should be taken into account, as savings for traditional architectural items replacement, savings in cooling/heating energy by means of it shading properties, energy savings on illuminations, etc.

But in order to compare locations for ETFE-MFM deployment, only pure electricity prices considerations will be taken into account.

A general equation for LCoE can be described as follows:

\[
\text{LCOE} = \frac{I + \sum_{t=1}^{T} \left( C_t \times \frac{(1 - TR)}{(1 + r)^t} \right) - \sum_{t=1}^{T} DEP_t \times TR}{\sum_{t=1}^{T} (1 + r)^t} \]

Where:

<table>
<thead>
<tr>
<th>Nomenclature</th>
<th>Unit</th>
<th>Meaning</th>
</tr>
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<tbody>
<tr>
<td>LCOE</td>
<td>€/kWh</td>
<td>Levelized Cost of Electricity</td>
</tr>
<tr>
<td>T</td>
<td>Years</td>
<td>Economic lifetime of the PV system</td>
</tr>
<tr>
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<td>Operation &amp; Maintenance (O&amp;M) costs and insurance costs on year t</td>
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<td>PV electricity generated on year t</td>
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<td>I</td>
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<td>r</td>
<td>%</td>
<td>Nominal discount rate (WACC)</td>
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<td>TR</td>
<td>%</td>
<td>Corporate Tax rate per country</td>
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<tr>
<td>DEP</td>
<td>€</td>
<td>Depreciation for tax purposes</td>
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Table 6. Description of LCOE components

As such, the variables that are paramount to derive the LCOE are the following:

- Average PV system lifespan (T)
- Initial investment (I)
- O&M costs and other operating costs (Ct)
- PV-generated electricity over the system’s lifespan (Et 16)
- Discount rate (r)
- Depreciation for tax purposes (DEP)
- Corporate tax rate (TR)

Investment cost
Investment costs include all costs related to the PV system: equipment purchase and installation, as well as costs for permitting and engineering.

O&M Costs
A commercial rooftop/façade PV system can be broadly considered maintenance free, requiring just a few hours of work per year. The main maintenance costs essentially cover cleaning of the PV modules, monitoring of inverters, controlling the electric system, among other tasks (an average of four hours of maintenance per year, valued at the corresponding local labor cost per hour). In addition, the cost of inverter replacement is added to O&M costs at the end of the inverter’s lifetime (year 15).

**Inverter Replacement**
The European Photovoltaic Industry Association (EPIA) assumes a technical guaranteed lifetime of inverters of 15 years in 2010 to 25 years in 2020. This means that the inverter will be changed once during the 30-year PV system lifetime. On the basis of sources such as EPIA, a 10% learning factor has been assumed for inverters within the commercial sector.

**Insurance Cost**
Insurance quotations for a 30 kWp PV system approximately range from 0.1% to 2.0% of the total system cost per year, adjusted for inflation will be considered.

**Corporate Tax Rate**
After-tax cost flows will be used to compute LCOE, which will be compared to the after-tax cost of electricity from the grid.

**Salvage Value**
The salvage value of a PV system is the value of the asset at the end of its useful life, which affects taxable income in different ways depending on the situation. If the equipment is sold or recycled, an inflow that increases taxable income should be accounted for. If costs are to be incurred in order to dismantle the installation, an outflow should be reported.

**Depreciation**
Depreciation for tax purposes is a means of recovering some part of the cost of the investment through reduced taxes, and the depreciation period will affect LCOE: all else being equal, a shorter depreciation period and a greater depreciation amount in the earlier years are preferred.

**Inflation Rate**
The estimated inflation rate is taken into account when calculating O&M and insurance costs of a PV system over its entire lifetime in each country.

**Discount Rate (r)**
For the LCOE calculation, project cost flows and the Weighted Average Cost of Capital (WACC) as discount rate is used.

**PV for self-consumption**
Motivations behind green investment Interest rates are usually determined by the real risk-free rate, plus several premiums such as that of inflation, default risk, maturity, and liquidity. When investing in a PV system, though, decision-making might be influenced not only by an economic return but also by non-economic factors, which are difficult to quantify. Firstly, individuals can make a “green investment” to hedge against rising prices of electricity from the utility, eliminating (generally a portion of) future price uncertainty. Moreover, PV investments are sometimes governed by non-economic motivations such as environment sustainability, social responsibility, security facing blackouts, etc.
3.2 The role of capital cost in PV LCoE

Contrary to what the majority of researchers assume, it was probably efficient from the point of view of costs and benefits to adopt PV first in northern countries. This was caused not so much by the solar radiation as by the lower WACC, particularly in OECD countries.

The lower WACC in these countries influenced the LCoE almost as significantly as the higher solar radiation in southern countries, while investment costs were generally lower in northern countries with more efficient markets for solar energy technologies.

From the perspective of resource and global efficiency, it would make sense to exploit solar energy in “Sunbelt” countries rather than in the “North” if similar investment and capital costs were attainable. While appropriate in principle, it looks like that the WACC influences the cost of solar PV more strongly than solar irradiation.

This conclusion is in opposition of past policy initiatives, and it carries implications for policy in the future.

With respect to the past, they indicate that development of PV, at a time when it required substantial subsidies, may not have been misplaced geographically. This conclusion contradicts the results provided by other scientific research. For example, Ummel (2010) suggests that solar resources shall be exploited first in places with high solar radiance such as the American southwest, Tibetan Plateau, Sahel, and Middle East, which are identified as major supply areas to satisfy the goal of providing 2,000 TWh of solar power or 7% of total consumption by 2020. Other researchers, such as Breyer and Gerlach (2013) identified the major relationship between solar irradiation and the cost of solar electricity.

Indeed, both the LCoE of PV and the subsidies required are almost as sensitive to differences in the cost of capital as they are to differences in the quality of the solar resource.

The existing studies on separate countries suggest that the sensitivity to the cost of capital or the discount rate is around 0.6. This means that every 10% change in the discount rate leads to a change of around 6% in the LCoE (Ondraczek, 2013). However, as the overall variation between countries is larger for the cost of capital than for the solar irradiance, the former effect outweighs the latter effect.

Granted, the money spent to raise capital to finance PV construction does not vanish; rather, it flows into the hands of financial institutions and investors. In countries where the cost of capital is higher, there would be a greater transfer of wealth from public funds or electricity rate payers—whoever is bearing the cost of the subsidy—to these actors, many of which operate globally.

3.3 Deploying the ETFE-MFM PV element

With respect to the natural ETFE-MFM market, the former analysis indicates that the:

Expansion of ETFE-MFM into less well-developed markets may be especially sensitive to efforts to make low cost capital more readily available.

---

Previous results, assuming uniformly low costs of raising capital, have indeed suggested that PV has already attained or is near attaining grid parity in many developing countries (Deichmann et al., 2011; Breyer and Gerlach, 2013). Grid parity is not widespread and policies to make capital for PV investment more competitive could take the place of PV subsidies as a means of stimulating market growth. Moreover, developing efficient solar markets in countries with a good solar-endowment might lower overall investment costs in these countries to levels seen in the most advanced countries.

Even in countries considered attractive from PV perspective, the possibility to develop PV can be dragged downwards by the general local conditions for investors, which includes the size of GDP and political/financial stability.

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10 Source: EPIA 2014, Unlooking the Sunbelt Potentials of Photovoltaics, 2010
4 Incentives policies. Incentive mechanisms and support schemes

In order to achieve the objectives of reducing emissions and promote more sustainable energy systems (e.g. EU Directives), many countries around the world have in recent years introduced various incentive mechanisms to electricity production from renewable energy sources.

As a rule, a combination of different nature incentives is present in the majority of countries where PV is being promoted. As a rule, a combination of different nature incentives is present in the majority of countries where PV is being promoted.

Three main types of mechanisms are distinguished: **Regulatory Policies, Financial Incentives and Public Financing**

<table>
<thead>
<tr>
<th>Incentive mechanism and support schemes</th>
<th>Regulatory Policies</th>
<th>Financial Incentives</th>
<th>Public Financing</th>
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<tr>
<td>Feed-in-Tariff (FiT)</td>
<td>Capital subsidy, grant, or rebate</td>
<td>Public/System Benefit Funds</td>
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<td>Premium Tariffs</td>
<td>Tax incentives and Credits</td>
<td>Public Investment and Financing</td>
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<td>Local content bonus</td>
<td>Reduced VAT</td>
<td>Public competitive bidding</td>
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<td>Utility Quota Obligation</td>
<td>Accelerated depreciation of assets</td>
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<td>Net Metering</td>
<td>Exemption from custom duties</td>
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<td>Obligation and Mandate</td>
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<td>Tradable Renewable Energy Certificate</td>
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*Table 7. List of Incentive mechanism and support schemes to photovoltaic*

The figures bellow shows the Renewable Policies state of the art and their evolution around the world.


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As a reference\textsuperscript{12}, please find below co-existence of different Incentive mechanism and support schemes to photovoltaic in some countries, up to 2013.

### Table 8. Summary of the support schemes available in the 28 countries

<table>
<thead>
<tr>
<th>REGULATORY POLICIES AND TARGETS</th>
<th>FISCAL INCENTIVES</th>
<th>PUBLIC FINANCING</th>
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<td>Uruguay</td>
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\textsuperscript{12} Taxes and incentives for renewable energy KPMG INTERNATIONAL September 2013
Regulatory Policies.

Within this category lay the following figures:

- Feed-in-Tariff (FiT)
- Premium Tariffs
- Local content bonus
- Utility Quota Obligation
- Net Metering
- Obligation and Mandate
- Tradable Renewable Energy Certificate

**Feed-in-Tariff (FiT)**: Generation rates (in English, "feed-in-tariffs", hereinafter FIT) or as a fixed price per kWh produced or added as a bonus to the selling price in the market ("feed-in-premium" FIP). Rates tend to be significantly higher than the market price of electricity, trying to compensate for lower externalities of renewable energy over conventional sources.

A FIT is a performance-based incentive rather than an investment-based incentive, and in that respect is more similar to production tax credits and the renewable energy credits of an RPS market than to investment tax credits or other investment subsidies. In several countries, FiTs are typically used in combination with one or more of these other incentives.

FIT programs are similar to net metering programs but differ significantly in one key aspect: the power generated by a utility customer's system is compensated at the rate set by the FIT rather than the retail electricity rate. This generation is treated independently from the customer's own electricity use, which is billed at the utility's regular retail rates.

**Variations on feed-in tariff policies**

In general, feed-in tariff rates that lead to significant additional renewable energy investment are set above the retail cost of electricity. The premium level may depend on the underlying program motivation and goals: FIT programs associated with more ambitious goals (e.g., an explicit capacity target, or a certain level of renewable energy credits to meet an RPS obligation, or to support a domestic renewable energy industry) may need to set the rate well in excess of the existing retail price. In a recent example, in 2012 Japan implemented a new FIT with particularly high PV tariff rates (more than 40 cents/kWh) as part of its post-Fukushima policy. However, without additional controls, generous FIT levels can lead to more investment than intended. One illustration is the Spanish experience, in which the government significantly reduced the tariff a year after its start, and suspended the FIT altogether in 2012, to contain costs to the government and other utility customers.

Feed-in tariffs vary widely in execution. Typically, feed-in tariffs will specify:

*Eligible technologies*—FITs generally include solar PV, but may include other renewable technologies. Other countries' FITs, particularly the German and Danish programs where the policy was tested and developed, initially focused on supporting wind. The FIT-eligible technologies generally overlap or

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coincide with RPS-eligible technologies.

Rate and contract terms—most contracts are long term (10-20 years). This assures project owners of a stable long term revenue stream. Utilities often set rates that depend on project size (smaller projects tend to receive higher rates) and technology (solar PV tends to receive higher rates than other technologies). Rates can also depend on the overall program goal or size limits (e.g., tariffs that decrease as capacity approaches the program ceiling), and utilities or states may revise their tariffs in cases of over- or under-subscription.

System size and sector restrictions—Most FIT programs have a maximum size for individual projects and may limit participation to certain sectors, like residential customers, for example, may apply only to residential systems up to 20 kilowatts (kW) and commercial systems up to 50 kW in size.

Program size limitations—most programs designate a cumulative ceiling, set either annually or at the program level, capping the amount of capacity that can take advantage of the tariff. This is an important cost containment mechanism for FIT programs.

For the Association of the European Photovoltaic Industry Association (EPIA), type FIT incentives are those that have shown greater effectiveness in the creation and development of PV markets.

Premium Tariffs: is the premium-price option, which offers a premium on top of the spot market electricity price. This achieves one of two objectives: i) to explicitly account for the environmental and societal attributes of RE, or ii) to help approximate RE generation costs. In this market-dependent model, the payment level is directly tied to the electricity market price, rewarding RE developers when market prices increase, and potentially penalizing them when they drop.

Local content bonus: it is a % per cent bonus on the purchase price of a solar system if at least % per cent of the added value of the entire installed system is local (regional, national, continental).

Utility Quota Obligation: Generally called Renewable Portfolio Standard (RPS), renewables obligations or quota policies. A standard requiring that a minimum percentage of generation sold or capacity installed is provided by renewable energy. Obligated utilities are required to ensure that the target is met. In this category falls also the “green certificates”, whereby generating utilities are required to achieve a certain percentage of their annual production from renewable energy sources, by obtaining green certificates (for example, for each MWh produced) that can be exchanged in the generation market with other companies. Under an RPS, declining price caps for the certificates can be included as a means to reduce long-term incentive levels. (Olz et al. 2008)

Net-metering/Net billing: It is a simple billing arrangement that ensures consumers who operate PV systems receive one for one credit for any electricity their systems generate in excess of the amount consumed within a billing period. In this case, production and consumption are compensated over a larger time frame (up to one year), and the network should be regarded as a long term storage solution, with the PV electricity being occasionally injected and consumed later on. In a net metering program, a utility effectively paid the customer the retail rate for any generation that is fed back into the grid. When this refund is done in kWh, we talk about net metering. If a monetary discount is done in the next electric bill, then we refer to net billing.

Obligation and Mandate: Requirement to include renewable energy in some capacity, such as building standards/regulations, biofuel blending, renewable energy installations in new construction, etc.

 Tradable Renewable Energy Certificates: Renewable Energy Certificates (RECs), also known as Green tags,
Renewable Energy Credits, Renewable Electricity Certificates, or Tradable Renewable Certificates (TRCs), are tradable, non-tangible energy commodities that represent proof that 1 megawatt-hour (MWh) of electricity was generated from an eligible renewable energy resource (renewable electricity). Solar renewable energy certificates (SRECs) are RECs that are specifically generated by solar energy. Tradable certificates have been used as a compliance mechanism for a variety of policies including Renewable Portfolio Standards (RPS) (also known as renewable energy mandates), renewable energy targets, and greenhouse emissions mitigation schemes such as cap and trade and carbon tax policies. Tradable certificates are also used in voluntary markets and are purchased by companies and organizations to reduce carbon footprints and support renewable energy markets.

 Tradable certificates alone may not be an effective policy if high non-economic barriers exist. (Olz et al. 2008) Investors may perceive higher risk with tradable certificate programs compared to other types of incentives where the support level is known (e.g., feed-in tariffs) and because of the typically shorter support periods. (Olz et al. 2008)

 Tradable certificates reflect the attributes of the generating facility at the time the power is generated. The location, time of generation, type of technology and fuel are a few characteristics that should be catalogued with the certificates. Only one entity can claim ownership of the tradable renewable certificates at a given time, They belong to the owner of the generating system unless the certificates are transferred to another party via a contract, sale, loan, or the certificates can be retired permanently. (Hamrin & Wingate 2003)

Financial Incentives. In this category lay the following figures:

- Capital subsidy, grant, or rebate
- Tax incentives and Credits
- Reduced VAT
- Accelerated depreciation of assets
- Exemption from custom duties
- Energy production payment

**Capital subsidy, grant, or rebate:** reduce the installed cost of a renewable energy project. Capital subsidies and grants are often paid in lump sum payments, while rebates are frequently determined on a $/kW basis. Capital Subsidies and Rebates For renewable energy rebates has to be used with other supporting policies to be effective, such as net metering and interconnection for example. (Kubert & Sinclair 2011) Consistency and duration improve the use of the incentive by avoiding confusion in the market and building awareness of the rebate. Rebates ideally should reflect existing market trends, cost of alternative technologies, and program goals (e.g., intended size of market). Incentive levels should be differentiated for residential, commercial, and public sectors. (Ellingson et al. 2010) Rebates set at the appropriate level incentivize market up-take while avoiding windfall profits to system owners. (Kubert & Sinclair 2011).

Declining incentive blocks contain program costs by reducing incentive amounts as target capacity levels are reached, reflecting increased economies of scale as markets mature. (Kubert & Sinclair 2011). Rebates are most effective when used for market-ready technologies with capacity for cost reductions. Complementary programs include tax incentives and feed-in tariffs. (Lantz et al. 2009) Grants Grants based on project needs ensure that sufficient funds are provided without over subsidizing the project; other incentives received by applicants should be considered when determining funding needs for a given project. (Kubert & Sinclair 2011) On-going project technical and financial assistance increases the likelihood of the project being completed on
time and successfully. Focused Requests for Proposals (RFPs) for grant applications enable programs to select projects that fit program goals. (Kubert & Sinclair 2011). Milestone-based payments encourage timely progress for the project by releasing funds once certain project implementation steps are met. Programs can also require milestone deposits that are released as the project reaches certain implementation steps. (Kubert & Sinclair 2011)

**Tax incentives and Credits** Governments can provide tax incentives to renewable energy projects by one of two ways. First, governments can reduce the liability of a particular tax via a deduction that allows a portion of the expense of a particular investment to be subtracted from a taxpayers’ adjusted gross income. Second, governments can provide tax credits, refundable tax credits, and cash grants that either allow the taxpayer to subtract a certain portion of the cost from the amount of taxes owed on a dollar-for-dollar basis or provide a refund if the credit exceeds the amount of gross tax owed. Main types of tax incentives used include: *corporate tax incentives, personal tax incentives, property tax incentives, and sales or value-added incentives.* Tax incentives have to be design to target certain markets, ownership types, etc., reflective of program goals, establishing an incentive with terms that reflect program goals. For example, if long-term market development is sought, create a policy that will be in place for 5 to 10 years. It is necessary to determine what level of tax incentive is needed to meet program goals (i.e., what level of incentive would result in how much market uptake, potentially?). Creating options such as tax pass-through and refundable credits for entities without a tax liability (e.g., local governments) expands the pool of possible participants. (Lantz & Doris 2009). Tax incentives can be paired with a variety of other policies and incentives, including renewable energy mandates/tradable certificates and rebates.

**Reduced VAT:** for renewables installations. In some countries, solar systems are defined as energy saving devices and a reduced rate of VAT can be charged.

**Accelerated depreciation of assets:** depreciation is an important tool for businesses to recover certain capital costs over the property’s lifetime. Allowing businesses to deduct the depreciable basis over a few years reduces tax liability and accelerates the rate of return on a solar investment. This has been a significant driver for the solar industry and other energy industries. Accelerated depreciation, along with other successful energy tax incentives has helped fuel unprecedented growth in annual solar installations. For instance, In Mexico, the cost of the investment can be deducted in full that same year, therefore accelerated depreciation is used (the investment becomes an expense on year 1). For all other countries, the straight-line depreciation method is used and a depreciation period of 15 years is assumed. Exemption from custom duties: tax exemption for import of goods under various export promotion schemes, such solar panels, inverters, electric equipment, etc.

**Renewable production payment (REP):** are a competitive alternative to Renewable Energy Credits (REC’s). Although the intent with both methods is the same, REP’s have proven to offer benefits to local jobs, businesses and economies while making the growth fundable and lendable by financial institutions. Renewable Energy Payments are the mechanisms or instruments at the heart of specific state, provincial or national renewable energy policies. REPs are incentives for homeowners, farmers, businesses, etc., to become producers of renewable energy, or to increase their production of renewable energy. As such, they increase our overall production and use of renewable energy, and decrease the consumption and burning of fossil fuels.

**Public Financing.** In this category lay the following figures:
Public/System Benefit Funds are collected through a variety of means, including €/kWh charges on electric and gas utility bills, flat charges on bills, and environmental and other fees from energy companies. Funds can be redistributed to support clean energy programs and incentives. It is necessary to determine goals for the fund before establishing programs and incentives to ensure that objectives are met, through setting measurable targets such as MW installed and monitor progress. Keep funding sources consistent, allow annual excess funds to carry over, and maintain funds for the programs. Appropriate legislative language and public acknowledgement of the benefits of the fund may help to prevent reallocation or a reduction in funds. Fund allocations, uses, and eligible technologies should be transparent to state officials, policymakers, and the public (REN21 2009). Renewable portfolio standards, energy efficiency standards, tax credits, and loan programs are complementary to public/system benefit funds.

Public Investment and Financing
Renewable energy companies often have difficulty gaining access to financing, and to address this barrier, governments have provided loans to renewable energy project developers and manufacturers. Often, these loans are “soft” loans consisting of any combination of below-market interest rates, longer loan tenors than those available from private banks, and interest payment holidays. In the U.S., several states and local governments have used revolving loan funds, which are intended to be self-sustaining with loan repayments recapitalizing the available funding. Governments have also made investments in research and development and facilities such as technology incubators in efforts to catalyse renewable energy deployment.

Public Investment: Technology research investment typically requires a long-term support commitment (e.g., 10 years). (U.S. EPA)

Public Financing: Programs that target borrowers unable to access financing at reasonable rates optimally leverage funds while avoiding competition with private loan markets. Longer amortization schedules enable payments to match cash flows from energy sold. Low interest rates attract participation to the programs, while low application burden reduces time and money spent on paperwork and fees. Partnering with lending organizations reduces administrative burdens. (Kubert & Sinclair 2011)

Public competitive bidding: Tendering system for contracts to construct and operate a particular project or a fixed quantity of renewable energy capacity. Competitive bids are offers extended by businesses in which they detail proposed compensation that they will receive in exchange for executing a specific task or tasks. These tasks can range from providing a service for a set period of time to manufacturing and transporting a certain quantity of goods or materials. Competitive bidding differs from other pricing strategies in that with bid pricing, a specific price is put forth for each possible job rather than a generic price that applies to all customers.

As a result of the existing former incentives, the economic viability of a PV installation could change dramatically when taking into account also administrative process, grid connection permit, financing and...
corporate legal-fiscal.

As an example, the European country map below summarises the results of the quantitative assessment of national frameworks for developing PV installations. The results are obtained by interviewing PV industry stakeholders in each participating country. Detailed national framework information, a practical description of the administrative requirements and more information on barriers, time horizons, efforts and costs involved in the development of a PV installation have been considered.

![Map showing national PV framework assessment](image)

**Fig. 10. National PV Framework Assessment by average Process Duration**

### 4.1 Post incentive era. PV self-consumption. “Prosumer”

In the mid-term future, market drivers are bound to change. “PV Competitiveness” has been reached in various segments and countries and support mechanisms will be phased out step by step. A key question in such a “post-incentive era” is how attractive an investment in owning PV generation will be for residential and commercial electricity consumers. It is thought that Smart Cities evolution (smart-grids) will boost the PV self-consumption in many regions.

Self-consumption is supposed to sustain significant rates of installation needed to fulfil countries’ renewable energy targets, and industrial consumers will integrate PV as a part of their power supply strategy (and thus make full use of available roof-tops and surfaces to enable renewable energy generation close to consumption).

**Self-consumption:** The possibility for any kind of electricity consumer to connect a photovoltaic system, with a capacity corresponding to his consumption, to his own system or to the grid, for his own or for on-site consumption and feeding the non-consumed electricity to the grid and receiving value for it.

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15 ENABLING THE EUROPEAN CONSUMER TO GENERATE POWER FOR SELF-CONSUMPTION November 2011. Sun Edison
Following this broad definition of self-consumption, it should be noted that the PV system providing self-consumption does not necessarily have to be owned by the consumer, but may be controlled by the consumer through a contractual arrangement with a third party owner. Also under this definition, power consumed by the owner or controller of the generator, might be consumed on-site or near the site through a dedicated line. Additionally, offsite generation and transport through the grid might be considered self-consumption as long as the PV generation is tied to a specific consumer\textsuperscript{16}.

Residential, commercial and industrial consumers are included, as are different application types of PV systems, from \textit{roof-top to façade mounted} or integrated to ground-based. This underscores that there exist a wide array of variations and associated investment cases and business models. These will also bring with them a range of policy, tax and legal issues to be resolved\textsuperscript{17}.

Self-consumption mechanisms have recently been promoted in several European countries. In some cases, pure net-metering schemes have been developed (such as in Belgium, Denmark and the Netherlands), while other countries have favoured mechanisms promoting an instantaneous consumption of the electricity produced. Various intermediate schemes exist between these two approaches.

In general terms, recent experience shows that net-metering schemes prove to be an efficient tool to kick-start a market or to develop a specific segment representing a limited installed capacity. With increasing PV penetration levels however, pure net-metering schemes ensuring a compensation of grid charges are raising the question of the system operators’ remuneration in the long run, and therefore potentially represent a barrier to innovation at the distribution level.

\textbf{Prosumer}: consumers who generate their own power, fleshing out the vision Hermann Scheer outlined in his 2005 Solar Manifesto: ‘Since everybody can actively take part, even on an individual basis, a solar strategy is ‘open’ in terms of public involvement… It will become possible to undermine the traditional energy system with highly efficient small-technology systems, and to launch a rebellion with thousands of individual steps that will evolve into a revolution of millions of individual steps.’

\textsuperscript{16} Position Paper July 2013 SELF CONSUMPTION OF PV ELECTRICITY - EPIA
\textsuperscript{17} Intersolar North America 2013: New Solar Photovoltaic Business Models in Germany and the U.S.
Mature PV markets. Share of PV in the EU 28

In the current debate on the financing of distribution grid operators, the cost of self-consumption and net-metering-driven installations requires to highlight their precise penetration. Fig. 12 shows the real penetration of these compensation measures in European markets. In addition it also shows the breakdown between self-consumed and net-metered electricity from PV systems.

![Fig. 12. PV contribution to the electricity demand in the EU 28 in 2013](image)

Based on the capacity installed and connected to the grid at the end of 2013, PV can currently provide roughly 3% of electricity demand in Europe, up from 1.15% at the end of 2010. In Italy, today more than 7.5% of the electricity comes from PV systems connected at the end of 2013. Greece jumped to the same level of electricity demand met with PV as Italy over the space of only three years. In Germany, this figure is more than 6.5% and Romania reached 2.5% in only one year. Ten other European countries are now meeting more than 1% of their electricity demand with PV, including Belgium and Bulgaria, with others progressing rapidly.

In most EU countries today, PV contributes to reducing the mid-day peak, competing directly with other peak generators. Considering that peak power generation represents roughly 50% of the electricity demand in Europe, these percentages take on a new dimension: PV can today provide 6% of the peak electricity demand in Europe, more than 15% in Italy and Greece, and more than 13% in Germany. This was achieved in just a few years and again shows how the development of PV electricity in Europe is occurring at a faster rate than almost anyone had expected.

4.2 Recommendations to boost PV self-consumption

If properly implemented, self-consumption of PV electricity can reduce and ultimately suppress the reliance on

Source. EPIA
The followings steps should therefore be implemented:

**Phase-out regulated electricity prices at retail level:** Regulated electricity prices at retail level should be phased out. In parallel, States should ensure that final consumers are able to better reap the benefits of a liberalized retail electricity market.

**Lift all regulatory barriers to self-consumption:** Every consumer should be allowed to consume the electricity she or he is producing. While some countries start favouring self-consumption, others do not allow for it or have set up schemes which discourage consumers to go for such an option.

**Ensure a fair distribution of grid costs:** Remuneration mechanisms necessary to cover the investments in the distribution grids will have to evolve in order to face a series of evolutions. In general terms, new financing models will have to ensure that each stakeholder will play its role. A differentiation of grid charges could be envisaged, reflecting the impact that a final consumer has on the grid.

When it comes to PV “prosumers”, the following arrangement should be pursued:

- **For the consumption component:** The electricity withdrawn from the grid (i.e. not produced by the PV system but consumed) should be subject to the same grid tariff rules as those applied to any other electricity consumer. As outlined above, this could be subject to a possible differentiation of grid charges on the basis of the impact that a final consumer has on the grid. Against this backdrop, self-consumed electricity should not be exposed to any grid costs and taxes, since it remains within a close system interacting neither with the distribution grid nor with the market. The effect of self-consumption on the reallocation of grid costs in this case is very similar to energy efficiency measures. The prosumer will simply have a different load profile, which should be addressed as any other evolving consumer’s load profile. This should be taken into account when assessing the effect of self-consumption on the reallocation of grid costs when it comes to discussions about future energy market designs.

- **For the production component:** For electricity injected into the grid in power system, costs of network operation for all power producers are generally borne by consumers, rather than generators. This rule should also apply for PV.

Once market failures are addressed and competitiveness is achieved, PV generators could progressively bear more responsibilities in terms of balancing. However, it should be noted that today’s market rules prevent a large majority of PV generators from participating in intra-day markets, so that they do not have a direct possibility to reduce their imbalances. It will therefore be important to develop frameworks favouring aggregation strategies and intra-day markets which are fit for variable RES, before attributing specifically any balancing costs to PV generators.

In general terms, arrangements for existing PV installations should be maintained and retroactive changes should be forbidden.

**Support the deployment of enablers:** Together with the roll-out of smart meters and the deployment of Demand Side Measures, storage at household or at local level will favour the development of self-consumption. When defining functionalities of smart meters, European Standardisation Organisations should
consider the ability to bi-directionally communicate on active/reactive power input/off-take; in addition, they should foresee the possibility of a greater remote controllability of power flows.

Aside from the R&D efforts which should be intensified, storage should be developed further. In particular, an assessment of the storage potential should be conducted at national level by 2014 and communicated to the European Commission. This could be reflected in the upcoming discussion paper on storage that should be published by the European Commission.

A better participation of demand in system management should be incentivized through the network codes currently being developed by ENTSO-E. More generally, strategies to develop demand response should be encouraged at European level.

Make the best use of the flexibility provided by the prosumer: Self-consumption appears as a genuine solution to develop PV. This will however require either adapting the load profile of electricity consumers to the PV production pattern, in particular through Demand Side Measures, or storing PV electricity to match the consumption needs over the day. In this sense, the prosumer will also become an increasing source of flexibility for DSOs.

With higher penetration rates of PV, this capability to adapt can be valorised as an ancillary service provided to the DSO against a fair remuneration:

- PV electricity (stored or not) can be used in some cases to stabilize local grids rather than being self-consumed;
- Demand Side Measures can be used in some cases to better manage the system instead of adapting to the PV production pattern.
- DSOs should explore ways of valorising and remunerating these capabilities, which may effectively limit overall grid costs.

Ensure a fair remuneration for the excess of electricity injected into the grid: Even with high levels of self-consumption, part of the electricity generated by a PV system will have to be injected into the grid. Developing an adequate power market design that allows for an appropriate remuneration of renewables in the long run will therefore be crucial if current support mechanisms are to be ultimately replaced. However, different distortions, barriers and fundamental market design problems will have to be solved before that. In particular, ensuring an access to wholesale electricity markets will be the key to valorise PV electricity and allow small prosumers to receive a fair remuneration for their excess of production, reflecting the real value of PV electricity at the time it is sold.

Aggregation will play as a facilitator in this process and should therefore be facilitated through dedicated regulatory national frameworks.
5 Global economy growth perspectives

In order to highlight geographical regions where the ETFE-MFE element can find a profitable market in next future, we have analysed the global growth perspectives for the next decades. The information has been extracted from “Medium and long-term scenarios for global growth and imbalances” report edited by OECD analysts.

![Fig. 13. % of world GDP prospect for different scenarios](image)

**Key countries:** India (6.5%), China (5.5%), Indonesia (5.1%), Turkey (4.1%), Brazil (3.9%), South Africa (3.8%), Chile (3.6%), Mexico (3.5%), Argentina (3.2%), Australia (3.0%), Czech Republic (3.0%), Russia (2.7%)

The methodology used a new modelling framework to extend the short-term projections, focused on the interaction between technological progress, demographic change, fiscal adjustment, current account imbalances and structural policies. The report predicts medium and long-term scenarios for global growth and imbalances long-term prospects and risks for the world economy.

By 2020, there will be major shifts in the world economic order in which emerging economies will become more important. China will overtake the USA to become the largest world economy in 2017 and there will be more emerging economies in the top ten economies by 2020 and beyond. The rise in importance of emerging economies will have implications for global consumption, investment and the environment. Large consumer markets in emerging economies will present enormous opportunities for businesses. However, income per capita will remain higher in the advanced world.

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19 OECD Economic Outlook, Volume 2012/1 © OECD 2012
20 OECD Economic Outlook 91 long-term database
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Fig. 14. Top 10 largest economies by GDP in PPP terms: 2010 and 2020
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Table 9. Growth in total economy potential output and its components. Annual averages, percentage change.
The relative size of economies will change dramatically. Growth in the non-OECD will outpace that of the OECD, shrinking gaps in living standards. The global saving rate will decline and be increasingly driven by China and India.

The main conclusion is that for the frame of 2018-2030, the potential growth scenario in near future shifts from OECD countries (2.2%) to non-OECD (5.1%). Demographic changes, including ageing, and fundamental forces of economic convergence will bring about massive shifts in the composition of global GDP.

![Fig. 15. Major changes in the composition of world GDP. Percent of world GDP](image)

The economic growth is predicted to be slow, as many countries face a long period of adjustment to erase the legacies of the crisis, particularly high unemployment, excess capacity and large fiscal imbalances. The scenarios suggest that gradual but ambitious fiscal consolidation and structural reforms could bring about substantial gains in growth as well as reducing a range of risks, particularly by reducing large fiscal and current account imbalances.

The next 40 years will see major changes in the relative size of economies, but large gaps in living standards will persist in 2050.
Outlook

- Fiscal and current account imbalances are expected to worsen.
- Consolidation needs to stabilise debt are substantial for many countries. On this basis there are large differences in the adequacy of current official plans.
- To reduce debt levels rapidly would require much greater consolidation.
- Sustaining fiscal consolidation would help reduce global imbalances and risks.
- Ambitious reforms could boost growth and reduce imbalances.
- OECD potential growth rates moderate over the long term mainly for demographic reasons.
- A higher oil price may lower growth but is unlikely to disrupt the recovery.
- The baseline scenario suggests a build-up of imbalances.
- Government indebtedness will be high and widespread among OECD countries.
- Many OECD countries require consolidation just to stabilize debt ratios. Reducing debt ratios to 60% would require greater consolidation.
- On a net debt measure the situation looks less worrisome in some countries.
- Sustained fiscal consolidation would lower interest rates and boost growth, but there may still be a trade-off between consolidation and growth.

Fig. 16. top 10 biggest economies: 2010 VS 2020
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<td>3.2</td>
<td>2.9</td>
<td>2.6</td>
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</tr>
<tr>
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<td>19.4</td>
<td>20.5</td>
<td>17.4</td>
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<td>20.4</td>
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### China

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<th>9.5</th>
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### Brasil

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### Potential Real GDP Growth (%)

| OECD            | 2.2 | 1.5 | 1.9 | 2.2 | 2.2 | 2.1 |
| Non-OECD        | 6.8 | 7.5 | 7.3 | 5.8 | 4.8 | 4.1 |
| World           | 2.8 | 2.7 | 3.4 | 3.5 | 3.2 | 3   |

*Table 10. Summary of scenario with more ambitious fiscal consolidation and structural reform*
6 Global construction market perspectives

The future markets for ETFE-MFM BIPV element will be chained to those regions where construction activity is supposed to grow strongest in next decades, especially to building construction and city invests and expansion. The baseline infrastructures and demographic pressure seems to play an important role.

In this chapter the evaluation of the volume of construction output in next decades is done. It is estimated to grow by more than 70% to $15 trillion worldwide by 2025. The meteoric growth, which outpaces that of global GDP, will be concentrated in three countries – China (China overtook the US to become the world’s largest construction market in 2010, and is expected to increase its global share from 18% today to 26% in 2025, despite an expected slowdown), the US and India (India will overtake Japan as the third-largest construction market with annual growth averaging 7.4% annually in construction expected to exceed that of China), with almost 60% of all global growth, while Emerging Asian are markets taking advantage of China slowdown (including Indonesia, Malaysia and the Philippines).

The construction market in Western Europe is expected to be almost 5% smaller in 2025 than its pre-recession peak in 2007, whilst North America is forecast to be almost 40% larger.

Construction output in emerging markets will be 16.7% of GDP by 2025, compared with 10.3% for developed countries, reflecting the higher investment requirements in industrialising economies.

Key countries: Qatar (10%), Nigeria (8%), India (7.4%), China (6%), Indonesia (6%), Mexico (5%), Vietnam (5%), Turkey (5%), Philippines (5%), Chile (>4%), Colombia (>4%), South Korea (3.5%), Canada (3.1%)

China, US and India drive Global Construction Growth to 2025

Outlook
China overtook the US as the world’s largest construction market in 2010, and now accounts for 18% of total global construction in 2012. By 2025, we forecast China will represent over a quarter of all construction output globally, even in 2020-25, growth will average over 6% pa, keeping China among the five fastest growing construction markets.

India will be a faster-growing construction market than China over the period from 2012 to 2025. India will overtake Japan as the third-largest construction market by 2022.

The US is still the second largest construction market. The US share of the global construction market is one and a half times that of Japan, the third largest construction market. The volume of construction output in the US will grow by over 75% between 2012 and 2025. Growth in construction continues to rise more strongly than GDP. Conversely, it is forecasted that the construction market in North America will be almost 40% larger by 2025

Qatar is Fastest Growing Construction Market Globally
Qatar is forecast to have the fastest growing construction market, with average double-digit growth of 10% p.a. between 2012 and 2025. Qatar will benefit from the country’s hosting of the FIFA 2022 World Cup and continuing diversification within its economy. Growth in construction volumes in Qatar is set to slow significantly after 2020.
**Europe, lost decade**

Weak economic fundamentals and stagnant (and in some cases declining) populations leave few growth opportunities in Western Europe. The construction market in Western Europe will be almost 5% smaller by 2025 than its 2007 peak. Stabilisation in Western Europe is one of the main drivers of the renewed global growth in construction output that we are expecting, after an 8% decline during 2012 and 2013.

We expect Germany to remain the largest construction market in Western. The UK stands out from the rest of Western Europe as a growth market. There is a pressing need to modernise ageing infrastructure and to build more new homes to prevent a widening housing deficit in the UK. stronger trade links to a growing US economy and more positive population and demographic drivers.

**Japan Boosted, but Longer-Term Trend is Weak**

In the short-term demand in Japan continues to be boosted by the rebuilding after the March 2011 earthquake and tsunami in north eastern Japan. This has been reinforced by the ambitious policy actions to combat deflation and shake off two decades of economic stagnation. The impact of accelerating population decline will offset this over the rest of the forecast horizon, with construction output slowing to well bellow 1% p.a. As a result, the size of the construction sector in 2025 will be about what it was in 2005, causing Japan's global share to fall from 8% to 5% of the total.

**Australia and Canada Experiencing Different Cycles**

Australia: minimal growth this year and next year, with small declines then following until 2025. This is likely to slow the rate of growth in total construction volumes from an average of 4.4% p.a. in 2005-12 to an average of 1.3% pa in 2012-25.

The outlook for Canada is robust, not only due to its tight trade links with The US, but due to an even more open immigration policy that will drive even faster population growth than the US. Canada has decades-long neglect of its highways, sewers and other municipal infrastructure, which will increase demand for construction whether governments like it or not. Average growth in Canadian infrastructure construction is expected to be 3.1% pa through 2025, more than double that in Australia.

**Growth in Emerging Asia**

The ‘Asian Tigers’ of the 1990s – of which South Korea and Taiwan are the key examples – have now slow down. South Korea, with growth averaging 3.5% pa in 2012-25, is the slowest-growing of the Emerging Asian construction markets we have examined.

The most dynamic new Asian Tiger construction market is Indonesia, the world’s fourth most populous nation. We expect the construction market to grow by an average of over 6% pa in 2012-25, raising its global ranking from 10th largest in 2012 to fifth largest in 2025.

Other new Asian Tiger construction markets include Vietnam and the Philippines, also expected to exceed 5% p.a. growth in 2012-25.

**Eastern Europe: Russia and Turkey Lead**

Construction output in Eastern Europe is forecast to increase by an average of 4.6% p.a. between 2012 and 2025, marginally higher than the global average. However, there are some key divergences with, for example, growth likely to be strongest in Russia and Turkey, in both cases exceeding 5% pa average over 2012-25.

Russia was the ninth largest construction market globally in 2012. In 2025, we expect Russia to be the sixth largest. Moreover, better infrastructure links and the ability to implement structural reforms should lead manufacturers towards Russia.
Construction volumes will grow more rapidly in Turkey than any other market in the region. Turkey will be supported by better long term economic fundamentals compared to neighbouring countries in the region. A more stable macroeconomic environment and strong trade links to fast growing emerging markets, such as those in East Asia, should help to attract investment. Urban population in particular in Turkey is expected to grow by around one-third.

**Latin America: Mexico, Chile and Colombia**

Growth in construction output in Latin America is expected to be slower than the global average. The largest Latin American construction market, Brazil, is only expected to see average growth in construction output of 2% p.a., much lower than the regional average. But long term growth will be constrained by the inability to enact deep and necessary reforms within the economy in order to unlock higher economic growth.

The expansion of mining capacity in Chile and expansion of extractive industries in Colombia will help to support longer term growth, while long term growth in Mexico will be aided by its proliferation of bilateral trade agreements, competitive exchange rate, low unit labour costs and longstanding deep trade links with the US. Overall, we believe construction in Chile and Colombia will grow at rates of over 4% p.a. or more between 2012 and 2025 but Mexico’s will be slightly higher at almost 5%. Brazil and Mexico are the world’s sixth and seventh largest housing markets globally by number of housing completions.

**Sub-Saharan Africa Second Fastest Growing Construction Region to 2025 After Emerging Asia**

The population of sub-Saharan Africa is rising fast, with total population expected to reach almost 1.2 billion by 2025, African nations are also urbanising fast and the urban population of sub-Saharan Africa is expected to grow almost 70% by 2025 and is also expected to become increasingly middle-class. As a result, there will be a significant need for construction of housing, urban transportation, medical and educational facilities.

It is expected Nigeria to be the second fastest growing construction market behind Qatar, with average growth in construction of 8% p.a. in 2012-25. GDP is also forecast to grow by an average of 5.4% p.a. over the same period, significantly above the global average, making Nigeria the fifth largest housing market in the world after the US.
7 Global PV market growth perspectives

7.1 Past evolution and baseline in 2013

While Asia started to dominate the market in the early 2000’s, the start of FIT-based incentives in Europe and in particular in Germany caused a major market uptake in Europe. While the market size grew from around 2 MW in 2000 to close to half a GW in 2003, the market started to grew very fast, thanks to European markets in 2004. From around 1 GW in 2004, the market reached close to 2.5 GW in 2007. In 2008, Spain fuelled market development while Europe achieved more than 80% of the global market, a performance repeated until 2010. While Europe still represents a major part of all installations globally, the share of Asia and America started to grow rapidly in 2012. This evolution is quite visible from 2010 to 2012, with the share of the Asia and Pacific region growing from 17% to almost 30%, whereas the European share of the PV market went down from 82% to 59% in two years.

Finally, for the first time in 2012, the share of the PV market in the Middle East and in Africa becomes visible as many countries have initiated PV programs and could appear on the map in the next coming years.

Germany installed 7.6 GW, after two years at similar levels of PV installations. This occurred in the context of reduced feed-in tariffs, pushing self-consumption as a natural driver of PV development in this country where the total installed PV capacity is now more than 32 GW. Behind the German leader, Italy is second with 3.6 GW installed in 2012, down from the tremendous and unsustainable 9.3 GW the previous year. Now that the financial cap set by the Italian authorities as a limit for the cost to be borne by electricity consumers has been passed, the future of Italian PV development will have to rely more on self-consumption than feed-in tariffs. The 16.4 GW installed in Italy will produce at least 6.9% of the electricity demand of the country in 2013, an undisputed world record.

China reached third place, with 3.5 GW installed: This performance is in line with the ambitions of the Chinese authorities to continue developing its internal PV market, pushing for 35 GW by the year 2015, starting now at 7 GW.

Close to the third place, the USA reached the 3.3 GW mark and now has about 7.2 GW of installed capacity. The fifth place goes to Japan, with 1.7 GW installed. This performance puts the total installed capacity in this country at 6.6 GW. Together, these countries represent 70% of all installations recorded in 2012 and slightly more in terms of installed capacity.
The following five places go to France (1,1 GW), Australia (1 GW), India (just below 1,0 GW), the UK (0,9 GW) and Greece (0,9 GW). Together these 10 countries cover 88% of the 2012 world market.

Smaller size countries have performed quite significantly and raised their total installed capacity above the GW mark: Belgium installed 600 MW and has now reached 2,7 GW while Korea has passed the GW mark with a more vigorous market than in the last few years. Some countries that grew dramatically over recent years have now stalled or experienced very small additions: Spain now totals 4,7 GW of PV systems followed by the Czech Re-public at 2,1 GW.

In Europe, net-metering systems allowed the market to grow quickly in Denmark (310 MW added) and the Netherlands (195 MW re-reported), with significant additions in Switzer-land (226 MW) and Austria (175 MW). In Asia, next to China, Japan and Korea, Thailand is progressing fast with preliminary data showing around 173 MW installed in 2012. Malaysia installed 27 MW for the first year of its feed-in tariff system. Taiwan installed 104 MW in a growing market.

In America, preliminary data for Canada shows the installation of 268 MW while the appetite for PV in Latin and Central America hasn’t transformed into a real market yet. Several GW of PV plants have been validated in Chile, but except in Peru with some 50 MW and Mexico with 15 MW, the real PV development of grid-connected PV plants hasn’t started yet in the region.

In the Middle East, Israel progressed rapidly, with close to 0,75% of its electricity already coming from PV while the PV installations in Turkey have started more slowly with around 2 MW installed in 2012.

Roof-top mounted. Decentralized generation

The evolution of grid-connected PV towards a balanced segmentation between centralized and decentralized PV has reversed course in 2012 in Europe: decentralized (rooftop) PV has evolved faster with several countries deciding to discontinue the support for utility-scale PV in Europe. This evolution has different causes: environmental concerns about the use of agricultural land, difficulties of reaching competitiveness with wholesale electricity prices in this segment, grid connection issues for instance. This doesn’t imply the end of development in the utility-scale segment in these countries but at least a rebalancing towards self-consumption driven business models.

The same pattern between decentralized and centralized PV is visible in the Asia Pacific region and in the America’s. However, this could change in the coming years, with the arrival of more developing countries that could focus on pure electricity generation rather than self-consumption driven business models. The availability of cheap capital for financing PV installations could reinforce this evolution25.

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7.2 PV global perspectives

PV remains a policy-driven business, where political decisions considerably influence potential market take-off or decline. The highest probability scenario assumes a low market in Europe and a growing market in most emerging regions.

While European electricity demand is stagnating, this is not the case globally and PV growth will continue to be driven by local and global energy demand. The fastest PV growth is expected to continue in China and South-East Asia in general, with Latin America, the MENA countries and India following. The rapid development of China’s PV market allowed it to take the first position among these countries, followed by a booming Japan (6.9 GW) and the USA with 4.8 GW. All three are expected to continue at the same level or even slightly more, with China probably above 10 GW for several years.

Key countries: China, Japan, USA, India, South Korea, Taiwan, Thailand, Malaysia, Canada, Mexico, Peru, Brazil, Chile.
The prospects of a record-breaking year for solar in China have helped propel the country to the top of Ernst & Young’s list of the world’s most attractive destinations for renewable energy investment. After a grapple with the US since the beginning of last year, China reclaimed the top slot in EY’s latest Renewable Energy Country Attractiveness Index and also the number one position for investment in solar\textsuperscript{26}.

EY said this was because of the increased government support and 8GW target set for distributed solar, which the consultancy said could help China replicate the “phenomenal growth” already seen in its utility-scale solar sector.

China’s government is placing increased emphasis on renewable energy as the country battles pollution, ushering in new market opportunities for foreign investors. Aggressive policy targets, an increased focus on consolidation and the roll-out of pilot carbon emissions trading schemes also support the country’s pollution reduction initiatives and reflect the renewables sector’s strategic economic value.

Germany managed to hold on to third place in the index, but EY warned that Europe’s solar pioneer should be “watched closely” as changes to the country’s EEG renewable energy laws, which have seen solar hit with new generation charges, take effect.

The report said Europe was at an “inflection point” whereby it is still striving to be a leader in renewables, but is under strain to maintain funding and supply capabilities. The industry must liberate itself from the shackles of the past and go in search of grid parity as the fastest route to secure and affordable energy. The role of policy-makers therefore becomes one of enablement rather than fiscal support, as well as looking to create a level playing field across all energy sources through greater cost transparency.

Japan also held on to fourth place, but it could change as the nuclear debate reopens.

The PV potential of the Sunbelt countries could range from 60 to 250 GW by 2020, and from 260 to 1,100 GW in 2030. And with the faster than expected price decrease in PV technology that the industry experienced in recent years, even more countries will see PV as a competitive energy source before the end of this decade.

More than 27 GW of new installations of PV systems occurred outside Europe in 2013, compared to 13.9 GW in 2012, 8 GW in 2011 and 3 GW in 2010.

Australia expanded rapidly in 2011 and 2012 with around 1 GW of new installations, but decreased to 830 MW in 2013.

India installed more than 1 GW, finally realising a (small) part of its huge potential.

In South Korea, 442 MW were installed, a sign that the market has restarted but remains rather low, constrained by a quota system and some additional incentives.

Some other countries experimented with embryonic PV markets: Taiwan had a 170 MW target for 2013 while Thailand, with a huge pipeline of projects, commissioned 317 MW, and Malaysia, where several manufacturers are producing, appears on the map with 57 MW.

\textsuperscript{26} RECAI Renewable Energy Country Attractiveness Index – February 2014
In the Americas, Canada has expanded with 444 MW, and Mexico and Peru installed several MW. Brazil and Chile, with their huge potential, have not commissioned many systems yet but the huge pipeline of potential projects in Chile should bring dozens of MW online in 2014.

In the Middle East²⁷ region, Israel remains the only country with a significant market (420 MW in 2013), while Saudi Arabia showed in 2012 and 2013 some interest for PV development that hasn’t yet materialised.

**Forecasts until 2018**

In the Low Scenario, the global market could remain between 35 and 39 GW annually in the five coming years. *The combination of declining European markets and the difficulty of establishing durable new markets in emerging countries could cause this market stagnation.*

While the decline of PV system prices in most markets paused in 2013, the installations that were triggered before that pause compensated for the EU decline. Most important markets outside Europe grew in 2013 and without these lost GW in Europe; the global PV market growth would have been even more impressive and reached well above 40 GW.

**Forecasts per rooftop**

In 2013 the rooftop segment represented more than 23 GW of total installations, higher than in 2012. With projections of *more than 35 GW installed by 2018*, this segment should experience stable growth from a global point of view. However, the world PV installation segmentation is changing: last year in a Low Scenario more than 27 GW were expected to be installed in the rooftop segment by 2017. This year, expectations have been lowered to slightly above 20 GW which means a stable market until 2018. This can be explained by a shift

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towards utility-scale plants in the Sunbelt markets, due to a different nature of the investors and less opposition to ground-mounted PV systems than in Europe.

The photovoltaic development forecast in key countries

Europe for many years has been dominant in the global PV market, but obviously there is a lot of growth potential in the rest of the countries of the world. Due to local and global energy demand to promote, the fastest PV growth will continue to be staged in solar project China and India, followed by Southeast Asia, Latin America, and the Middle East and North African countries.

China
China has the potential to very quickly become the number one PV market in the world. Adequate policies are being put in place progressively and will allow the market to continue growing fast. Latest predictions point out that China is to install 206GW by 2030. Estimate the potential of the Chinese market in the next five years, especially in the current low price levels, is excellent. The total installed capacity in 2016 is likely to exceed 35GW, to when the annual market of up to 10GW.
The Chinese market has finally started after National People's Congress in 2011 reaffirmed the importance of renewable energy sources in the "12th Five-Year Plan, in order to cope with increasing electricity prices and electricity demand. China’s current co-existence of three policy incentives:

• Golden Sun plans, projections about 1.7GW of large-scale photovoltaic projects completed this year.

• The PV construction projects mainly focused on photovoltaic architectural BAPV of BIPV and BIPV, through subsidies to the completion of the established capacity target.

• New Tariff Act, which was released in July 2011 and triggered the rapid market development. Local governments continue to increase in the basis of the national standard tariff subsidies, such as Zhejiang, Shandong, Jiangsu and Liaoning.

United States
The United States is the only economically developed countries to be able to absorb a large number of PV projects, in addition to other projects supported many other public utilities projects will be spawned out. Taking into account all of the above situation, the installed capacity of the U.S. market in 2012 is likely to reach at least 3GW, which also makes the smooth realization of the 10GW target 2016.
The US PV market has been driven by tax credits granted by the federal US government for some years with net-metering offered in some states as complementary measures. In 2011, 80% of the market in the United States focused on the following seven states: California (30%), New Jersey, Arizona, New Mexico, Colorado, Pennsylvania and New York. It can be observed a balanced development of the market in the residential, commercial and utility. Residential systems accounted for 15% of new installed capacity, its development are increasingly due by the third-party owners instead of homeowners.

Renting rooftop solar systems has taken off and is expected to continue to be popular; making up 68% of the residential US solar market in 2012, with residential system prices dropping 14% between the 2011 and 2012.

GLOBAL MARKET OUTLOOK for Photovoltaics 2014-2018
In terms of annual installations, California still ranked as the top state, followed by Arizona, New Jersey, Nevada and North Carolina.

Commercial systems (accounting for nearly 45% of the market share) are mainly concentrated in California and New Jersey, and other states, including Massachusetts, Maryland, North Carolina and Arizona are expected there will be a significant development.

**US active incentive policy**

Public utilities projects is the main force of the U.S. market.

- **State rebates** have played a significant role in accelerating the deployment of solar installations in the United States by reducing the upfront cost of owning a system. These programmes vary widely by incentive level, annual budget, installer and equipment requirements, installation results, and other criteria. They are active in California and a dozen other states with various results.

- **Tax credits** help offset the expense of purchasing and installing solar energy systems by directly reducing the project owner's tax liability and can play an important role in promoting solar, especially in states where direct incentives such as rebates and grants are not available. State tax credits vary widely by eligibility criteria, incentive level, annual budget, installer and equipment requirements, and other criteria. They are active in Arizona, North Carolina, Hawaii, and several other states.

- **Net-metering** has developed as an alternative way of supporting the deployment of PV and is implemented in more than 40 states. But the debate has started about the consequences of net-metering policies for utilities and some changes could appear in 2013 and after.

- **RPS policies** have been set up in several states with a solar provision. The quota varies from one state to another, ranging from 0.2% of solar by 2018 in North Carolina to 4.1% in New Jersey by 2027. In some cases, solar quotas are not specified but distributed generation is targeted: This is the case for Arizona for instance.

- **Third party PPAs** are allowed in more than 20 states.

- **PACE programmes** have been introduced in more than 20 states as well; PACE (Property Assessed Clean Energy) is a means of financing renewable energy systems and energy efficiency measures. It also allows avoiding significant upfront investments and eases the inclusion of the PV system cost in case of property sale.

- **Power purchase agreements (PPAs)** are the main factors to promote the development of this part of the market, there are about 9GW signed PPAs agreement the project will be completed within the next five years installation (3GW projects have financing in place and the ground was broken).

**India**

India’s National Solar Plan (JJNSM) has started in January 2010. Its purpose is to achieve the Government’s to the 2022 target of 22GW of power generation (20GW grid system, 2GW of off-grid system). The project started slowly, especially grid systems, such a fragmented situation is mainly caused by the policy in the region. At the state level, the Gujarat looks the most attractive state: renewable portfolio standard (RPS) in 2012-2013 increased from 5% to 7%, with 1% of the photovoltaic power generation. In addition, additional PV incentive policies have been introduced.

The state of Rajasthan, India has signed and developers 1.5GW of photovoltaic projects. Although there has so far been installed goal of the state is vaguer, 10GW-12GW amount is only intended to be completed in the next 10 years. PV plays a more important role in a number of other states, such as Tamil Nadu, Andhra, Punjab Pradesh Kendall Karna Tucker and the state of Maharashtra, etc., they have taken a
series of positive measures, and launched its own project planning and appropriate feed-in tariff.

**Japan**
Japan’s energy reformers celebrate the solar boom as proof of the country’s smooth transition away from nuclear—technology deemed too dangerous after Fukushima’s meltdown. The country is projected to install solar capacity this year equivalent to five to seven nuclear plants. The power shortage will promote the rapid development of the PV in the next few years.

Despite some unfavourable conditions, Japan’s PV installed in 2011 has reached 1296MW, and is expected to usher in greater development. The official goal is to be reached in 2020 28GW, and the real size of the market may be higher. In 2030, the Japanese government plans to 40% of the national demand for electricity from renewable energy, which the Photovoltaic should account for at least 53GW. At the same time, the country’s authorities estimated that the real potential for PV in Japan about 230GW.

**Residential photovoltaic generation**
Japan is ranked third in the world in terms of installed photovoltaic generation capacity (3,618 thousand kW), of which, residential use accounts for 80% and non-residential use accounts for 20% (the ratio is opposite in Europe and the U.S.).

Following the introduction of the surplus electricity purchase system in 2009, the installed photovoltaic generation capacity for residential use has increased rapidly. PV generation has spread to 900,000 households (the total number of detached houses in Japan is 27 million). In the future, the key is to make PV systems “household appliances” in cooperation with rechargeable batteries and smart meters.

As of 2010, the residential PV systems accounted for 95% of the Japanese market, but in 2011, a variety of installed systems toward balance, residential systems accounted for about 80%, more than 16% of commercial and industrial roofing. According to the new tariff law in July 2012, more than 10 kilowatts of residential systems and commercial / industrial system of more than 500 kilowatts are also eligible for the tariff subsidy.

**Canada**
Policy-driven, the Canadian market in 2016, the cumulative installed capacity will reach 4.2GW. This growth is mainly by Ontario, the province relies on generous feed-in tariff. Ontario introduced a strip bar for local suppliers, developers of the project at least 60% of the products from the local. In early 2012, Ontario’s feed-in tariff level has dropped, but a number of other provinces in the progressive development of the PV market people focus not just Ontario.

**Ontario’s Feed-in Tariff Program**: This FiT programme is North America’s first comprehensive guaranteed pricing structure for electricity production from RES. It aims at targeting 10,7 GW of non-hydro RES sources by 2018 in the province under its current Long Term Energy Plan. The first part targets generators above 10 kW (the “FiT Programme”) while the second part focuses on systems below that limit (“MicroFiT programme”). PV systems can be granted the FiT for a period of 20 years. A particularity of this programme is the imposition of a 60% domestic (Ontario) content policy: This regulation was challenged in front of the WTO that ruled against Ontario in 2012 with a possible appeal in 2013

**Australia**
With rapidly evolving support schemes, at national and state level, the Australian market evolved quite rapidly. A combination of good solar irradiation, rising electricity prices and the difficulty bringing the grid to remote areas has pushed the PV market ahead.

The variety of PV support programs in Australia has made it a complex market, which also makes the market highly unstable. Unlike many European countries, Australia feed-in tariff is based on the state-based. This
makes it very different policy options between the states. Some stakeholders to promote a national program to replace all state feed-in tariff in order to parallel the development of the country’s PV market. At the same time, some states have been considering phasing out of fiscal incentives. In the short term, the Australia national unified grid tariff is unlikely to be realized, which may temporarily slow down the development of the market.

**South Korea**

Various incentives have been used to support PV development. In 2008, the “Third Basic Plan for the Promotion of Technological Development, Use, and Diffusion of New and Renewable Energy” based on the “First National Energy Basic Plan” was issued. This plan includes the construction of “One Million Green Homes” and “200 Green Villages” by 2020. Based on this plan, the RPS (Renewable Portfolio Standards) scheme will replace the existing “Feed-in-Tariff” scheme from 2012 onwards. The RPS was launched in 2012 as planned and will be active until 2020. The PV installed capacity in the country began to decline in 2009 and 2010, and even more so in 2011, only to install a 92MW. Due to the constraints of the policy, the market potential is large, but in the next five years, South Korea’s annual installed capacity may be limited in the 200MW-500MW per year. Since 2012, the Tariff program for renewable energy quota system (RPS) is in place, this standard specifies the power enterprises obliged to produce a certain number of new energy power, photovoltaic power generation naturally occupy a certain share.

**Mexico**

On December 21, 2013, Mexico’s sweeping and historic energy reform bill formally became law. On August 12, 2014, a package of energy reform legislation became law in Mexico, which includes nine new laws as well as amendments to existing laws, implements the December 2013 constitutional energy reform and establishes a new legal framework for Mexico’s energy industry. Secondary legislation in the package includes a new independent role for grid operator CENACE, requirements to procure renewable energy, enables companies to directly sign electricity contracts with renewable energy generators, and mandates the creation of a system of renewable energy certificates. It’s going to be a liberalized market where solar developers can come in as independent power producers and develop projects. Additionally, there is language in the law that allows for competition between clean energy sources in different geographic locations at the lowest cost. A fixed-price power purchase agreements system is expected.

The new legislation does not include the Small Power Producer Program, under which Mexican renewable energy producers were required to sell electricity at fluctuating prices based on a percentage of the spot price.

The new energy system is not going to start being in place until early 2015. The slow pace of energy sector reform has driven down the previous 2014 forecast for the Mexican solar market by around 150 MW. However, it is expected the nation to be the largest solar market in Latin America over the next five years.

The price of PV electricity for households with high electricity consumption (DAC) is already attractive from an economic point of view since they pay more than twice the price of standard consumers. At the end of 2012, around 1 600 customers were using this scheme. Since 2012, this net-metering is also available for multi-family housing, with pre-arranged shares.

In December 2012, the National Fund for Energy Savings announced the start of a new financing scheme for PV systems for DAC consumers: 5 year loans with low interest rates can be used to finance PV systems.

**Brazil**

With around 45 MW installed at the end of 2012, mostly off-grid, PV remains a marginal source of electricity in
the country. PV hasn’t yet reached competitiveness with retail electricity prices: Beginning 2013, prices were reduced by 18 to 26% for end consumers, which will push away grid parity in the country.

New regulations have been approved including tax breaks on PV systems up to 30 MW in size. This could develop the market in the segment of large PV plants. Energy regulator ANEEL has received applications for PV plants totalling 1 GW, with capacity in between 1 and 30 MW. But larger projects have been investigated by developers in the country. Even if all of these projects won’t be realized in the end, they show an interest for PV as a source of clean electricity in Brazil.

Some projects aim at selling electricity on the regional electricity market to provide electricity to industrial companies.

In addition, a new net-metering system has been put in place for systems up to 1 MW and will be active in 2013. This system allows compensating production and consumption over a period of 36 months. This compensation will be organized by rate periods (peak PV electricity can compensate for peak consumption and in the same way for off-peak production). Net-metering is allowed between distant production and consumption sites if they belong to the same user and take place in the same grid area.

Some states are pushing harder (Amazonas for instance) but mainly for small scale PV plants off-grid so far. Finally, Brazil will open energy auctions to PV for the first time in 2013. Some expect PV developers to apply to several GW of PV projects.

This could lead to a real market start in 2013-2014 with hundreds of MW installed each year.

Chile

In March 2012 a net-billing regulation was introduced for systems up to 100 kW: PV electricity in excess can be valued at a price lower than the retail price (depending on the conditions, this could be the equivalent of the market price). So far this law hasn’t entered into force and is thus not yet applicable.

Chile experienced a boom in PV projects announcements in 2012 that hasn’t yet materialized in real installation numbers. 3,6 MW were installed by the end of 2012, but much more are expected in the coming years. The country is divided into 4 independent electricity grids and most projects are concentrated in the northern one where all mining sites are located. Lack of power generation in the region of the Atacama Desert is pushing electricity prices quite high.

More than 2,4 GW of large PV projects were approved at the end of 2012 and more than 1,5 GW received an environmental permit. Nevertheless, huge uncertainties remain about most projects’ timelines.

Renewable energy quotas oblige utilities to buy at least 5% of their annual traded electricity from RES but no provision for PV exists as such.

Malaysia

The PV market grew significantly in 2012, however remaining at a low level (2 MW for residential installations, 20 MW for non-residential). 34 MW of PV systems are currently producing electricity, including off-grid systems. In addition to grid-connected PV installations, 8 MW of off-grid systems were in operation in the country. Numbers have been revised downwards in 2012.

The National Renewable Energy Policy and Action Plan (NREPAP) provide long-term goals and commitment to deploy renewable energy resources in Malaysia. The objectives of NREPAP include not only the growth of RES sources in the electricity mix but also reasonable costs and industry development. The Sustainable Energy Development Authority Malaysia or SEDA Malaysia was established on 1st September 2011 with the important responsibility to implement and administer the Feed-in Tariff mechanism.

At end of December 2012, SEDA Malaysia had approved a total of 914 applications for 168.98 MW) for PV and these constituted 95.2% of the total applications approved under the FIT programme. Solar PV constituted 37.48% from the total installed capacity approved under the Programme. The FiT Programme is funded by a Renewable Energy Fund (RE Fund) funded by electricity consumers via a 1% collection from the consumers’ monthly electricity bills. Small consumers with consumption below 300 kWh per month are exempted from
contributing to the fund. Due to the limited amount of the RE Fund, the FiT is designed with a cap for each technology.

**BIPV installations are incentivized with an additional premium on the top of the Feed-in Tariff.**

**Indonesia**

By the end of 2025, the Government of Indonesia has targeted a share of electricity produced from renewables of 25%, with solar at the 0.2-0.3% level, equivalent to 1.0 GW of PV installations. The forthcoming FITs may accelerate the PV demand in Indonesia, making it the second largest PV market in the Southeast Asia region.

**Thailand**

At the end of 2012, the cumulative grid-connected PV power reached 383 MW or 92% of total solar power installation, with between 30 to 40 MW of off-grid applications. The introduction of a feed-in premium or “adder” in Thailand in 2007 aimed at promoting the development of grid-connected PV. This “adder” comes in addition to the regular tariff of electricity, around 3 THB/kWh. While the government planned initially 500 MW of solar installations (PV and CSP together) by 2020, the target was rapidly overshot, with more than 3 000 MW of solar project proposals that have applied for the financial support scheme. New applications for the Very Small Power Producer (VSPP) and the Small Power Producer (SPP) scheme have been stopped by the government due to the huge number of projects received.

In addition, the “adder” prices for solar generation have been decreased from 8 THB per kWh (0.258 USD/kWh) to 6.5 THB per kWh (0.2098 USD/kWh).

At the end of 2011, the solar power generation target was increased to 2 000 MW, in order to cope with the new Energy Development Plan. This one targets 25% of renewable energy under the 10-Year Alternative Energy Development Plan (2012-2021).

In 2013, the solar power generation target has been increased to 3 GW together with the reopening of the solar PV rooftop VSPP scheme with a new feed-in tariff (100 MW for small rooftops below 10 kW; 100 MW for commercial and industrial rooftops between 10 and 250 kW and large scale rooftops be-tween 250 kW and 1 MW). FiT prices have been fixed at 6.96 THB per kWh (0.2245 USD per kWh) for residential size, 6.55 THB per kWh (0.2113 USD per kWh) for medium buildings and industrial plants and 6.16 THB per kWh (0.1987 USD per kWh) for large buildings and industrial plants. The FiT will be paid during 25 years.

In addition, the Thai Government also approved the so-called “community solar” power generation scheme of 800 MW. This scheme will be implemented by cooperation between the Ministry of Energy and the National Village and Urban Community Office, under the Prime Ministry Office. The stepwise FiT prices for this scheme will decrease from 9.75 THB per kWh for the first three years, down to 65 THB per kWh in the seven following years and finally 4.5 THB per kWh until the 25th year. These 800 MW are planned to be completed by the end of 2014. Apart from these two promotion schemes, the Government also approved 25 MW of rooftop PV installations for Government buildings.

With these schemes, Thailand aims at continuing the deployment of grid-connected PV in the rooftop segments, after a rapid start in the utility-scale segment.

**Taiwan**

In 2012 Taiwan installed about 104.5 MW mostly as grid-connected roof top installations. The total installed capacity at end of 2012 is estimated at 222 MW. The official target for 2013 has been set-up at 130 MW. The market is supported by a feed-in tariff scheme guaranteed for 20 years and administered by the Bureau of Energy, Ministry of Economic Affairs. This scheme is part of the Renewable Energy Development Act (REDA) passed in 2009 that drove the development of PV in Taiwan. The initially generous feed-in tariff was combined with capital subsidy. It has later been reduced and now applies with different tariffs to rooftops and ground-mounted systems. Larger systems and ground based systems have to be approved in a competitive bidding
process based on the lowest FiT offered. A bidding process for 2013 will target 90 MW of additional PV systems. In order to cope with declining prices of PV systems, feed-in tariffs were reduced in 2012. The target is split in two parts: One for systems granted through the bidding process and one for the non-bidding process. Bids are scheduled monthly.

Property owners can receive a further capital subsidy. It is the intention to favour small scale roof-tops at the expense of larger systems, in particular ground based installations. So far, agricultural facilities and commercial rooftops have led the market. The country targets 420 MW of PV installations in 2015 and 3.1 GW in 2030. In 2012, Taiwan launched the “Million Roof Solar Project” aiming at developing the PV market in the country, with the support of municipalities. The authorization process has been simplified in 2012 in order to facilitate the deployment of PV systems and will most probably ease the development of PV within the official targets.

South Africa
South Africa is often seen as the most attractive emerging markets. But until now its PV market share is still low, the majority of PV projects under construction focus in a large public facilities. In 2014, through the renewable energy power purchase plan (REIPP) incentive, the government is expected to be at least 1450MW of PV systems installed. The plan is based on a tender basis, and taking into account the socio-economic development factors established.

For no more than 5MW of small systems, the Government intends to introduce new independent plans, but so far has not announced any news. The start of the South African market will be to reach 2GW installed capacity in 2016. However, there are some issues to be resolved; in particular the financing cost is a major problem for bidders.

Countries of the Middle East and Africa (MEA)
The Middle East is boosting its solar power sector with $6.8 billion worth of projects in the pipeline. The huge solar potential of these countries, and the growing need for new generation capacities, has not materialized yet in a real PV market, but the five coming years will be decisive to trigger that development.

A Trade Arabia report said that around 10 major projects are set to be plugged in the United Arab Emirates, Kuwait, Oman, Egypt, Jordan and Morocco. The economics of switching to solar energy are far better than in South Africa, India, Brazil, China and the U.S. While the Middles East possesses vast potential of solar power, experts are urging the governments to implement key policies and regulations that will facilitate immediate investments in the industry as well as accelerate the deployment of the solar energy projects.

In the MEA region, barriers to PV deployment persist, with the subsidised prices of electricity and the lack of appropriate regulatory frameworks. Nevertheless, awareness among policymakers progresses significantly in several North African countries that are setting ambitious targets for RES for 2020.

The potential of rooftop PV applications has been clearly underestimated in the region so far, with a focus on large projects, hiding other perspectives that should be taken into account.

Without subsidies on retail electricity prices, other segments in other countries of the region could have reached competitiveness already. The main obstacle to PV development lies then in the regulatory framework and the cost of financing PV investment.

Political instability in Egypt, Tunisia and other countries in the region could delay investments, especially in large projects, by increasing the risk premium sought by financing institutions. The risk of local content legislation could also slow down development. The current turmoil in many countries of the region could delay the set-up of the Mediterranean Solar Plan launched in 2010, while the prospects for Desertec beyond 2020 remain valid.
**Morocco**
Already in Morocco current PV system prices are competitive with industrial electricity prices. Morocco has launched a 2 GW solar plan with a dedicated implementing agency, under which PV and Concentrated Solar Power (CSP) technologies will compete openly. In parallel to the solar plan for large installations, there could be some room for smaller systems in the coming years. Morocco has perhaps the most reason of any nation in the region to pursue solar, given its lack of local fossil fuel resources. The purchase of imported fuel represents an enormous cost in Morocco, which must be borne by consumers and the government in the form of subsidies.

**United Arab Emirates.**
Capable of financing photovoltaic resource-rich United Arab Emirates development of photovoltaic power generation will be handier. In large buildings, the building-integrated photovoltaic (BIPV) project can contribute to a faster than expected development. Street lights installed away from the comb the city lighting as well as in remote desert areas also will help the growth of PV installed capacity in the United Arab Emirates. Some 10MW of photovoltaic systems have been installed in Abu Dhabi and connected to the grid, and the 100MW project still in the bidding stage.

**Saudi Arabia**
Saudi Arabia is also promising, with a growing awareness and interest from policymakers, while the first large systems have been installed or planned (megawatt scale rooftops in Saudi Arabia, preliminary test site for large ground mounted installations in Jordan). The early stage of large-scale ground power station exploration work has been carried out in Saudi Arabia.

**Jordan**
In Jordan, on-going discussions could lead this year to a new regulatory framework for PV. MW-level roof system is carried out in Jordan.

**Nigeria**
Nigeria has a population of more than 155,989,000. It is the most populous country in Africa, with more than 73 million living in urban areas. Per capita emissions are relatively low, at about 0.64 tonnes of CO$_2$ per year. Nigeria has one of the least energy-efficient economies in the world (ranking 21 out of 186 globally)$^1$. As the biggest oil producer in Africa, Nigeria’s economy is dominated by oil and gas. Total CO$_2$ in the energy sector are expected to grow by 2.2 per cent annually$^2$. Nigeria has implemented a variety of plans and policies with a view to scaling up investment in renewable energy. Resources are being mobilised under the Clean Technology Fund to improve access to finance for energy efficiency and renewable energy roll-outs. The Federal Government plans to generate 2.483 Megawatts of electricity from renewable energy sources by 2015. In the medium term, the Federal Government has planned to increase the generation from renewable sources to 8.188MW by 2020 and 23.134 by 2030. Renewable energy is expected to contribute about 1.3 % to the country's energy mix by 2015. The draft was approved by the ECOWAS Centre for Renewable Energy and Energy Efficiency in May 2013.

**Other African countries**
Policy-makers, especially the leaders of the North African countries, their consciousness and progress faster, which also makes several North African countries to set a massive plan to develop renewable energy in 2020. These countries' growing demand for electricity and better lighting resources destined photovoltaic power generation is not a flash in the pan, a big leap in the next five years.
In other African countries, the question of regulatory stability and cost of financing has so far prevented the take-off of the PV market. Regardless, the LCOE of PV has reached the retail price of electricity in several countries, which should herald its incoming competitiveness. Burkina Faso, Chad, Liberia, Madagascar, Mali, Senegal and Uganda already have reached this threshold. In the commercial/industrial segment, Burundi, Cameroon, Central African Republic, Ivory Coast, Gabon, Gambia, Ghana, Guinea, Rwanda, Senegal and Togo already have LCOEs for PV systems, in ideal financing conditions, that are below the retail prices of electricity. While these results should be considered carefully, and while the real competitiveness point is always further than the traditional comparison with electricity prices, it is clear that the potential market for PV systems in those countries could be triggered under adequate regulatory frameworks and investment stability.

Other South and Central America Countries

Given the political stability, economic growth and reliable financing and other factors, some important national PV market in the next few years may occur rapidly. According to research A.Gerlach and Ch.Breyer report shows, some countries have the ability to price below grid production of photovoltaic electricity. Residential systems are being developed in El Salvador, Guyana, several Caribbean Islands, and Suriname. Commercial / industrial PV systems in countries such as Belize, Brazil, Chile, Guatemala, Honduras, Mexico, Nicaragua and Panama, the same can be achieved grid parity.

Several countries in Central and Latin America have put support schemes in place for PV electricity. Ecuador is becoming a small but promising market with FiT legislation (0,40 USD/kWh – 15 years) in place and some ground mounted projects (up to 30 MW) announced as being built in 2013. Uruguay announced the intention to launch a call for tender for 200 MW of PV with a PPA in early 2013 at the low 90 USD/MWh rate. The net-metering system launched in 2010 failed to develop the market so far. In Peru a double 20 MW plant that has been operational since end 2012 was inaugurated begin 2013. Other plants are foreseen until 2014. This comes from an 80 MW blind bidding process launched in 2010 with a ceiling tariff fixed at 0,269 USD/kWh. The Dominican Republic is validating a 100 MW project to be completed in 2014. Next to this, a net-metering system and tax breaks are supposed to develop the small-scale residential and commercial markets. French overseas departments have seen an important increase of PV penetration in the last years, with 34 MW in French Guyana, 60 MW in Martinique and 64 MW in Guadeloupe and some smaller numbers in Saint Martin. They represent so far the largest density of PV installations in the Caribbean region.

Europe

Overall, the future of the European market is uncertain for the coming years. The drastic decrease of some FiT programs will push some markets down in 2014, with a limited number of emerging markets in Europe that could offset any major decline. Given these new conditions, the short-term prospects for the European markets are stable in the best case, and could even decline.

Without support from policymakers for PV, the transition to a cost-competitive PV market driven less by financial support schemes could be difficult over the five years to come, with a rather low market in Europe (around 6-8 GW). The market could stabilize in 2014 and grow again from 2015 onwards, driven by the approaching competitiveness of PV and emerging markets in Europe.

This would require a stabilization in the largest European markets (Germany, Italy), a continuation of current policies in the UK and a renewed uptake in Spain and possibly France, and a soft landing of markets in the final years before 2018 (especially in Greece and Romania). The contribution of middle size markets such as Belgium, the Netherlands, Denmark, Switzerland, Austria and Portugal could help maintain the market at its 2013 level during the coming years.

The countries where PV has not developed until now will be interesting to follow in the coming years, because of their untapped potential but also for the unique opportunity to witness a different market development than what was experienced until now in most European countries. The history of PV proves that a stable policy...
framework using support schemes in a sustainable way increases market confidence. Poland, Croatia, Hungary and to a lesser extent Ireland could develop in the coming years in various forms. Outside of the European Union, Turkey and some Balkan states will become focal points. Amongst the “old” markets, the rebirth of France, at the heart of the European grid, should be carefully followed and encouraged in a way that suits the specifics of this country. In a similar way, PV will not redevelop in Spain unless solutions can be found to the relative isolation of the country from a grid perspective. Finally, the concept of prosumers seems to increasingly generate interest, but its materialization in real markets remains unsure, depending also on regulatory framework conditions, including the allocation of charges and taxes. In 2013, the sum of installations that were at least partially driven by self-consumption in Europe amounted to over 2 GW. The question is how fast presumes will become central actors of PV development in Europe.

2020 potential and targets in the EU

EPIA’s report “Connecting the Sun: Solar photovoltaic on the road to large-scale grid integration”, published in 2012, identifies several possible PV deployment scenarios to 2020 and 2030 that represent the technology’s potential in line with the current economic and regulatory environment.

- The Baseline scenario envisages a 4% share of the electricity demand in the EU provided by PV in 2020. This represents about 130 GW of cumulative capacity by 2020. In 2030, PV could represent up to 10% of the electricity demand.
- The Accelerated scenario, with PV meeting 8% of the demand, represents about 200 GW of cumulative capacity by 2020. In 2030, PV could target up to 15% of the electricity demand.

EPIA has compared various PV market forecasts until 2018 against the two scenarios developed in the “Connecting the Sun” report as described above, as well as the NREAPs:

- The Low Global Market Outlook Scenario for PV until 2018 that used to be aligned with the 4% target (Connecting the Sun’s Baseline scenario) appears now to be slightly higher. This represents a rather stable perspective compared to previous EPIA forecasts. Thus, it looks reasonable to expect that 4-5% penetration for PV could be reached even in the low growth case.
- The High Global Market Outlook Scenario for PV until 2018 appears increasingly unlikely to be fully realized. While this scenario of reaching 8% by 2020 looked coherent and in line with optimistic market expectations, the current political backlash has led to a revision of this objective downwards to around 7%. Reaching a substantially higher share would require a real paradigm shift in the way PV is supported and incentivized, even after cost-competitiveness is reached in many countries and market segments. It is clear today that more ambitious scenarios are not realistic options anymore and would require tremendous market developments, currently unsupported by public policies in Europe.
- The NREAPs as devised in 2009 are far from the reality of today’s PV market. Apart from Germany and Greece (which defined ambitious targets), market evolution in most countries could easily overtake the action plans. Future expectations largely reflect the current balance of installations, with Germany and Italy dominating the market. In the EU forecasts, the NREAPs targets with the intermediary value for 2015 have been taken into account. The extent to which they have underestimated the market developments from 2012 and even 2013 is obvious.

Medium-term scenario for 2030

EPIA scenarios (published in 2012) show that PV penetration in Europe in 2030 could be between 10% and 15% of electricity demand. As outlined before however, with current market trends it is quite unlikely that the 8% scenario – which would have corresponded to a 15% share in 2030 - will be fully reached by 2020. Building on these trends, and without major changes of policy, a share between 7% and 11% of PV in European
electricity demand appears realistic. The potential for 2020 is roughly twice as high as the levels foreseen in the NREAPs, pushing towards at least 150 GW compared to 84 GW. In fact, with 81.5 GW installed by the end of 2013, the Europewide NREAP target of 84 GW will already be reached in 2014.
8 Support schemes to PV roof-top and BIPV in key countries for ETFE-MFM element.

Following the analysis carried out in previous three chapters, it is clear that there exists a bunch of countries in which simultaneously the conditions for further growth of the construction market, economic growth (GDP) and PV market growth will be given. It is expected that these countries will become the natural market for ETFE-MFM item.

This chapter discusses in detail the different support schemes for PV in such key countries, which can mean an important decision support for stakeholder in the adoption of the ETFE-MFM BIPV solution.

The volume of construction in China, US, India represents and will represent more than half of the total volume. Estimates of economic growth in India and China are the highest, and presumably in the three countries tremendous growth of the PV market. Japan will continue to rank high for a few years, both in construction and level of PV installed. Indonesia appears as a great opportunity, as well as Turkey, Mexico, Chile and Brazil. Canada shows up as a solid market for ETFE-MFM. Southeast Asia also looks attractive, with South Korea, Thailand, Philippines and Vietnam principally which is expected rapid growth of the PV market. In Latin America, apart from those already mentioned, Colombia is beginning to implement policies favourable to PV. In Africa, Nigeria stands as a great opportunity, awaiting some stimulus policies favourable to PV. Beside its great potential, Russia does not seem very favourable to PV, at least for rooftop installation. Europe in general is a mature and stagnant market, where highlights UK. Only favourable PV policies in UE28 can allow an opportunity for the ETFE-MFM.

The following chart resumes at a glance the most promising perspectives countries for ETFE-MFM element taking into account growth forecast for construction business, PV market and global economics.

To this group of countries belongs those with an historical strong position (US, Japan, Canada), those of consolidated baseline during the last years (China, India), and some others with emerging perspectives, both in Asian and Latin America (Brazil, Mexico, Chile, Colombia) and Mid-East. Finally, a few African countries have shown up recently as a consequence of political stability.
8.1 Support schemes in presumed ETFE-MFM market\textsuperscript{30}

\textbf{Qatar}

\textit{Renewable energy target:} 20\% of energy from renewables by 2024. Qatar has also made a commitment to be the first carbon-neutral World Cup in 2022. In November 2013 Qatar outlined its plans to install over 200MW of solar in the country. This is the first step the government has taken to achieving its goals and the 200MW will be installed across several rooftops covering huge water reservoirs of water. At the same time the country has pledge to run a completely carbon neutral world cup in 2022, it is not yet known what extra installations will be brought out to achieve this goal and whether they will be mostly restricted to \textit{residential roof-top installation}.

Qatar is a country which has recently begun to realize its full solar potential. Whilst it has large oil and gas fields, its energy needs continue to rise and the country is fast establishing itself with the key facilities and knowledge to build a vibrant solar economy. At present it is not known how the projects will be tendered and the scope for involvement by non-Qatari companies. However, the with sites already selected and national utility KAHRAMAA firmly behind them, financing will certainly not be an issue.

\textbf{KAHRAMAA/Qatar Electricity and Water Company (QEWC)}

The QEWC is the main utility in Qatar and is involved in power generation and desalination processes. It is the developer of the 200MW of solar projects and has also been instrumental in writing the grid codes to support the interconnection of large-scale PV.

\textbf{Energy debates}

In January 2010, KAHRAMAA announced their intention to enforce a new law on the conservation of water and energy. This law requires the installation of water and electricity meters in all new buildings, as well as improving the minimum standards for insulation in the buildings.

\footnote{\textsuperscript{30} REN21 Renewables Interactive Map 1 \url{http://www.map.ren21.net/#fr-FR/search/by technology/4,15,11,15,13,16,14,19,20,27,21,18,22} Generated on: 08/22/2014}
The Chevron Corporation established the Chevron Center for Sustainable Energy Efficiency (CSEE) to support Qatar’s sustainable development through research, demonstration and training in solar power and energy efficiency. The $20 million CSEE is located at Qatar Science and Technology Park (QSTP) and studies solar power, air conditioning and lighting technologies suited to Qatar’s buildings and climate. It is joining forces with GreenGulf, a Qatar renewable energy company, to establish a major solar test facility at QSTP. Qatar is currently building an ‘Energy City’ which will invite multinational natural gas and oil companies to set up headquarters there to become the ‘next major energy hub’ and a centre for ‘regional operations and global hydrocarbon development’. The project aims for ‘creating a sustainable blueprint for future development’ and its buildings will incorporate the latest green technology. Solar energy will be used in some parts of the city and ‘intelligent solutions designed to promote energy efficiency, improve air and water quality and reduce waste stream’ will be implemented.

**China**

On August 30, China announced to implement a new Feed-In Tariff (FIT) for solar photovoltaic (PV) power including utility ground power plant and distributed generation. This long-expected pricing scheme will make China PV market more solid as it safeguards the PV project’s return rate. With the FIT in place, a catalyst to the PV industry, Chinese PV incentive policies are going to a finale.

**Chinese new PV FIT**

China officially initiated PV subsidy of 1.15 yuan (19 U.S. cents) per kilowatt-hour (KWh) in 2011, and the subsidy was lowered in the same year and kept to 1 yuan (16 U.S. cents) per KWh till the new FIT ready. The original subsidy is only suitable to utility ground power plant, while the new FIT covers both utility (usually ground type) and DG (usually roof-top type).

For utility PV ground power, the new FIT has been set at 0.9 yuan (14 U.S. cents), 0.95 yuan (15 U.S. cents) and 1 yuan (16 U.S. cents) per KWh based on solar radiation levels where the plant locates. The distributed PV projects get a subsidy of 0.42 yuan (7 U.S. cents) per KWh generated, plus coal-fire power price which is around 0.20 - 0.36 yuan (3 - 6 U.S. cents) per KWh if surplus electricity feeds back to the grid. The FIT, scheduled to last 20 years, will apply to all PV projects registered after September 1 this year. Those, registered before September 2013 and connected to grid by the end of 2013, will enjoy the previously universal FIT of 1 yuan (16 U.S. cents) per KWh. Therefore, a rush installation in China could be expected in the remaining of this year, which is estimated at 5GW.

It makes the investors of PV projects in China have a foreseeable return of 8-10%. So the boom of China PV market is expected as a result of FIT mechanism, along with the 35GW domestic installation plan by 2015.

Regional solar tariff zones: China's PV tariffs have been divided into regions according to local weather advantage and construction costs.

Three regional zones for utility PV projects have been determined; zone 1 covers mostly northern China and Inner Mongolia areas with a tariff of CNY0.9/kWh (US$0.147).Zone 2’s tariff is set at CNY0.95/kWh (US$0.155) for mainly western and central regions of China, and zone 3 at CNY1.0 /kWh (US$0.163) for the remaining regions.

For smaller distributed PV projects, a tariff of CNY0.42/kWh (US$0.07) has been set, incorporated with the use of the generation capacity policy. The new tariff does not apply to PV projects benefiting from central government investment subsidies. The tariffs have been set for a benchmark period of 20 years, but to sustain market competition, tariffs and subsidies will be reduced in correlation with production costs and generation scale. The rates will apply to projects approved after the 1 September 2013, or approved but not operational until 1 January 2014.

The new solar tariff regions are specified as follows:

Zone 1 – CNY0.9/kWh

Ningxia, Qinghai Haixi, Gansu Jiayuguan, Wuwei, Zhangye, Jiuquan, Dunhuang, Jinchang, Xinjiang Hami, Tacheng, Altay, Karamay, Inner Mongolia region excluding Chifeng, Tongliao, Xing’anmeng and Hulunbeier.
Zone 2 – CNY0.95/kWh
Beijing, Tianjin, Heilongjiang, Jilin, Liaoning, Sichuan, Yunnan, Inner Mongolia Chifeng, Tongliao, Xing'anmeng, 
Hulunbeier, Hebei Chengde, Zhangjiakou, Tangshan, Qinhuangdao, Datong, Shanxi, Xinzhou, Shanxi Yulin, 
Yan'an, Qinghai, Gansu, Xinjiang regions that not covered by Zone I

Zone 3 – CNY1.0/kWh- Regions that not covered by Zone 1 and 2.
According to market research firm IHS Technology, the NEA has vowed to continue support for the PV industry 
and upcoming policy changes could help lift barriers for DPV and speed up development of new projects.
NEA recommends the following changes to its Distributed (rooftop) PV policies, which will become key drivers 
when ratified by the National Development and Reform Commission later this year:
Expanding the definition of eligible DPV projects, possibility to include all systems up to 20 MW in size (not 
necessarily roof-mounted) that connect to a low-voltage grid.
In addition to the likely change above, the grid voltage limit of eligible DPV systems may be increased from 10 
kV to 35 kV. The change in definition of what the NEA considers a DPV project would open up incentives to a 
large number of ground-mount PV projects.
DPV subsidies may more than double to be close to FiT rates, up from CNY 0.42 ($0.07) per watt to between 
CNY 0.90 and CNY 1 per watt, depending on areas of installation.
The NEA is trying to establish a communication platform between government, banks and companies. It 
encourages the establishment of a one-stop financial solution for DPV companies that would include support 
from a PV industry investment fund.

US

In the United States there is a single market for photovoltaic solar technology, but a conglomerate of regional 
marks with different incentives. Since these mechanisms are changing constantly, for a fresh update, some 
organization as the DSIRE (Database of State Incentives for Renewables and Efficiency) for information on 
incentives and policies that promote renewable energy and energy efficiency has been created. DSIRE Solar 
is a comprehensize source of information on state, federal and local incentives and policies promoting the 
adoption of solar technologies. (http://www.dsireusa.org/summarytables/finre.cfm).

As explained in previous chapters, the US incentive mechanisms is complex and several incentives works at the 
same time, making US market very attractive to PV. Among them:

- 3rd-Party Solar PPA Policies
- Energy Efficiency Resource Standards
- Grant Programs for Renewables
- Interconnection Policies
- Loan Programs for Renewables
- Net Metering Policies
- Net Metering Policies (Treatment of Net Excess Generation)
- PACE Financing Policies
- Property Tax Incentives for Renewables
- Public Benefits Funds for Renewables
- Rebate Programs for Renewables
- RPS Policies
- Sales Tax Incentives for Renewables
- Tax Credits for Renewables
### Implementation Policies for Architectural PV

<table>
<thead>
<tr>
<th>State</th>
<th>Personal Tax</th>
<th>Corporate Tax</th>
<th>Sales Tax</th>
<th>Property Tax</th>
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**ETFE**

**Multifunctional Modules**
As a resume, here is a brief resume of what the incentives have been:

**National**

U.S. Financial Incentives, Rules, Regulations and Policies Covers corporate incentives, solar loan and grant programs, personal exemptions and credits, as well as energy standards and federal green power goals.

**Financial Incentives**

**Corporate Depreciation**
Modified Accelerated Cost-Recovery System (MACRS)
Corporate Exemption
  Residential Energy Conservation Subsidy Exclusion (Corporate)
Corporate Tax Credit
  Business Energy Investment Tax Credit (ITC)
Federal Grant Program
  Tribal Energy Program Grant
  USDA - High Energy Cost Grant Program
  USDA - Rural Energy for America Program (REAP) Grants
Federal Loan Program
  Clean Renewable Energy Bonds (CREBs)
  Energy-Efficient Mortgages
  Qualified Energy Conservation Bonds (QECBs)
  U.S. Department of Energy - Loan Guarantee Program
  USDA - Rural Energy for America Program (REAP) Loan Guarantees
Personal Exemption
  Residential Energy Conservation Subsidy Exclusion (Personal)
Personal Tax Credit
  Residential Renewable Energy Tax Credit

Rules, Regulations & Policies

Energy Standards for Public Buildings
  Energy Goals and Standards for Federal Government
Green Power Purchasing
  U.S. Federal Government - Green Power Purchasing Goal
Interconnection
  Interconnection Standards for Small Generators

State Incentives (http://www.pvpower.com/SolarIncentives.html)

Arizona
The Governor recently signed three solar-related bills. House Bill 2332 will allow school districts greater flexibility in making renewable energy part of buying power, while HB 2336 will give cities and counties authority to create special incentives and taxing districts (like Berkeley-style financing). Senate Bill 1403 will provide incentives for solar manufacturers to locate in Arizona. The ACC is holding an adjudication procedural conference to decide if Solar Service Agreements (PPAs) are subject to regulation as Public Service Corporations. At the beginning of June, Salt River Project (SRP) reduced solar rebate to $2.70/watt residential, $2.25/watt commercial

California
California Energy Commission: Up to date information on California's solar initiatives. California Rebate Tracker: Detail on the level of rebate each of the California utilities offer. California Solar Energy Site: Key California government website, dedicated to solar policy, incentives and rebates. The CPUC approved the 500 MW Southern California Edison (SCE) solar programs. A bill to expand the cap on net-metering peak load from 2.5% to 5% passed the Assembly and now moves to the Senate (AB 560). The Sacramento Municipal Utilities District (SMUD) will begin offering a feed-in tariff in January 2010. Customer-
sited distributed generation systems up to 5 MW are eligible, with a total program cap of 100 MW (see article). In June, California’s Attorney General argued that feed-in tariffs as proposed in California are not only permitted under federal law but should be used to encourage the rapid growth of renewable energy. City of Palm Desert’s Energy Independence Program fully allocated $2.5 million within the first several hours of the third round of funding. Half of the funds have been committed to solar installations and the other half committed to energy efficiency improvements.

Colorado
The Governor’s Office has indicated that they will make an announcement sometime in August or September. Effective September 1, 2009, customers may make a one-time election to roll over excess kilowatt-hour credits indefinitely and the individual system capacity limit was changed from 2 MW to 120% of the annual consumption of the site. These net-metering changes were part of SB 51. Xcel is proposing a “backup power” fee on residential PV systems. Xcel estimates that for an average Boulder home with a 4.5 kW solar system, the annual charge would be about $23 (see article in Denver Post). The Colorado Public Utilities Commission (PUC) will hold a public hearing on Xcel’s fee proposal next week.

Connecticut
Senate Bill 85 improved state-wide net-metering. The bill extends net-metering to farm service customers for systems up to 100 kW; removes a provision requiring annual forfeiture of net excess generation; grants customer-generators ownership of all renewable energy credits (RECs); and increases the aggregate capacity cap of all net-metered systems from 1% to 5% of a utility’s peak load.

Florida
Florida Renewable Energy Association, Florida Alliance for Renewable Energy (FARE) A progressive organization promoting “Feed In Tariffs” and “Renewable Energy Dividends” to promote rapid adoption of solar and renewable energy, with Gainsville as a recent success story. Progress Energy announced a $1.50-2.00/watt rebate for residential systems and also committed to offering a production incentive for commercial systems. Their goal is to install 1 MW of residential systems per year for 10 years, and 5 MW of commercial systems per year for 10 years. The Solar Alliance is encouraging FPL to offer a similar program through a proceeding at the PSC. An additional $5 million from Recovery Act funding has been committed to the state rebate program, with a possible $9.4 million more to come.

Hawaii
The Governor recently signed Senate Bill 464, which makes the state renewable energy credit refundable for taxpayers who agree to accept a lower credit of 24.5%. HB 1464, also signed by the Governor, increases the RPS to 25% by 2020 and 40% by 2030.

Massachusetts
Northeast Sustainable Energy Association
Massachusetts will use $20 million in stimulus funds to install large solar PV systems on state and municipal sites.

Minnesota
Minnesota's solar rebate program now offers incentives of $1.75/watt (or $2.00/watt if the installer is NABCEP-certified). Incentives are only available for residential applications up to 5 kW and small business applications up to 10 kW, although larger systems may be funded up to these limits. 2009 program budget is $400,000, plus $2.75 million expected from Recovery Act funds.
Nevada
Solar Nevada Sunrise Sustainable Resources Group
SB 358 was recently signed by the Governor. The bill expands the RPS to 25% by 2025, increases the solar carve out to 6% starting in 2016, adds incentives for 2 MW on schools, and allows Berkeley-style financing.

New Jersey
Northeast Sustainable Energy Association
PSE&G has received approval from the Board of Public Utilities (BPU) to invest $515 million in 80 MW of solar projects, doubling the state’s solar capacity. Called Solar 4 All, the program has two segments, each 40 MW in size. The first segment consists of installing solar on 200,000 utility poles in PSE&G’s service territory, and the second segment will focus on centralized solar, with PSE&G developing solar installations on facilities it owns and at third-party sites. A website is now available for the SREC-Based Financing Program offered by Atlantic City Electric Company (ACE) and Jersey Central Power & Light Company (JCP&L). The RFP is scheduled to be released during the week of July 27, 2009.

New Mexico
New Mexico Solar Energy Association
SB 237 extended the 6% corporate tax credit to large-scale installations with a minimum capacity of 1 MW and a maximum credit of $60 million (see DSIRE record). Another bill expanded the state tax credit for homeowners and small businesses to 10% with a maximum of $9,000 per project, allowing a combined state and federal tax credit of 40%. For small and medium systems, Xcel Energy now offers a production incentive at a rate of $0.20/kWh generated on systems installed after February 9, 2009, and $0.10/kWh on existing systems. Xcel Energy also will pay credits on larger systems at a price determined through a RFP process (see DSIRE record).

New York
Northeast Sustainable Energy Association
New York’s solar incentive program has received supplemental funding of $15 million in order to continue operations through 2009. The addition increases the total 2008-2009 program budget to roughly $75 million (see DSIRE record). NYSERDA will partner with the Long Island Power Authority (LIPA) to install 50 MW of solar with support from $27 million in Recovery Act funds.

Pennsylvania
Northeast Sustainable Energy Association
The Solar Alliance is supporting the passage of House Bill 80, which would increase the solar carve-out in the RPS from .5 to 3% in 2026 and give the PUC authority to set an ACP. The Governor recently approved a 15% tax credit for solar projects and $23 million in grants and loans to fund eight solar projects.

Rhode Island
Northeast Sustainable Energy Association
The Governor recently signed a bill that will retroactively change net-metering laws. The customer now can have the net excess generation (NEG) credited to the customer’s next billing period at a rate that is slightly less than the utility’s retail rate; or receive compensation in the form of a monthly check for NEG.

South Carolina
South Carolina Solar Council
Net-metering has been expanded to 20 kW for residential, 100 kW for commercial and applies to all investor-
owned utilities including Duke Energy, Progress Energy and South Carolina Electric and Gas. Net excess generation (NEG) is credited to the customer’s next bill at the utility’s retail rate, and then surrendered to the utility annually at the beginning of each summer season (see DSIRE record).

**Tennessee**
Tennessee Solar Energy Association
Tennessee has committed Recovery Act funding to building the West Tennessee Solar Farm, a five-megawatt, 15-acre power generation facility at the 1,720-acre Haywood County industrial site. The State of Tennessee now offers a 40% grant on the cost of a commercial solar system, up to $75,000 per system. Total program budget is $3.75 million.

**Texas**
Texas Solar Energy Association
Although our solar bills failed in the state legislature, the solar industry is involved in a regulatory proceeding at the PUC that would effectively implement the 500 MW non-wind RPS. CPS in San Antonio restarted the rebate program at $3.00/watt and expanded maximum rebate to $30,000 for residential, $100,000 commercial.

**Vermont**
Northeast Sustainable Energy Association
A bill to create a Feed-in tariff program was signed by the Governor. The program includes 50 MW cap, project size cap of 2.2 MW, and contract of 20 years at $0.30/kWh.

**Washington**
Solar Washington
Washington State now offers a production incentive ranging from $0.12 to $0.54 per kWh depending on where the products are manufactured, with a maximum incentive of $5,000 per year. Participants in community solar projects can receive an incentive ranging from $0.30 to $1.08 per kWh, with a max incentive of $5,000 per year.

**India**
Several incentives are available for rooftop solar PV plants through the Jawaharlal Nehru National Solar Mission. Both central and state governments have launched various schemes to incentivize rooftop solar power in India. The Central policy support for rooftop solar plants includes:
- Accelerated depreciation
- MNRE subsidy
- Renewable Energy Certificates
Several states provide additional incentives based on their solar policies
Net metering, or reward for excess power supplied to the grid, is slowly gaining ground in India. Permissions required for installing grid connected rooftop solar systems primarily involve receiving approvals from the local power distribution authorities, who may need to ensure that the grid infrastructure does not become congested.

**Central schemes**
Accelerated Depreciation (AD): Accelerated depreciation of 80% is available under the Income Tax act for rooftop solar PV systems. This can provide significant savings to a solar plant developer who is a taxable assessee and has sufficient profits against which the depreciation can be charged.

MNRE Subsidy: The Ministry of New and Renewable Energy (MNRE) provides Central Financial Assistance through capital and/or interest subsidy (depending on the nature of the applicant). The summary of the subsidy scheme is provided in the table:

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<th>Category</th>
<th>Maximum capacity (kW)</th>
<th>System with battery back-up</th>
<th>System without battery back-up</th>
<th>Interest subsidy</th>
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<td>Individuals for all applications</td>
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<td>Rs 51/watt or 30% of project cost whichever is less</td>
<td>Rs 30/watt or 30% of project cost whichever is less</td>
<td>Soft loans@5% p.a.</td>
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<td>Individuals for irrigation, &amp; community drinking water applications</td>
<td>5</td>
<td>Rs 51/watt or 30% of project cost whichever is less</td>
<td>Rs 30/watt or 30% of project cost whichever is less</td>
<td>Soft loans@5% p.a.</td>
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<td>Non-commercial/Industrial applications</td>
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<td>Rs 51/watt or 30% of project cost whichever is less</td>
<td>Rs 30/watt or 30% of project cost whichever is less</td>
<td>Soft loans@5% p.a.</td>
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<tr>
<td>Non-commercial/Industrial mini-grids</td>
<td>250</td>
<td>Rs 90/watt or 30% of project cost whichever is less</td>
<td></td>
<td>Soft loans@5% p.a.</td>
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Table 13. Indian Central support schemes

for commercial/industrial entities either of capital or interest subsidy will be available

Note: 1 The benchmark cost for setting up a solar PV plant is Rs. 170/Wp (With battery providing 6 hours of autonomy) and Rs. 100 per Wp (without battery) i.e. if the actual project cost exceeds this amount then project cost will be deemed to be the benchmark cost for calculating the subsidy.

Note 2: Benchmark costs are for systems with 5-year warranty for all components (inverters, batteries, switchgear, etc.) other than PV modules which are warranted for 90% of output at end of year 10 and 80% at end of year 25. PV modules have to be made in India to avail subsidy.

Note 3: Capital subsidy is increased to 90% of benchmark cost for special category states (North Eastern states, Sikkim, Jammu & Kashmir, Himachal Pradesh, and Uttarakhand).

The subsidy calculation is illustrated in this table:

Renewable Energy Certificates (RECs): Renewable Energy Certificates are an avenue to further monetise your rooftop solar PV plant. RECs are available for rooftop plants of 250 kW or greater capacity. Every 1 MWh (1,000 units) of energy generated is eligible for 1 REC. These RECs are traded on power exchanges, where they are sold to organisations that need to satisfy a Renewable Purchase Obligation (typically utilities).

Criteria
- The project should have a minimum generating capacity of 250 kW
- The power generated should not be sold to any distribution licensee at a preferential tariff
- Captive solar power generators should not be
- Availing promotional wheeling charges
- Availing promotional banking charges
- Not receiving any exemption/waiver of electricity taxes or duties
Only grid-connected projects can avail RECs. Off-grid projects are not eligible.

- The solar project should be accredited with the State Nodal Agency 6 months prior to the date of commissioning of the project.
- The solar project should be registered with the Central Agency 3 months prior to the date of commissioning of the project.
- The solar generator has to apply to the Central Agency for the RECs based on electricity generated that is certified by the State Load Despatch Centre (SLDC) through a separate meter.
- Issued RECs can be traded only through power exchanges through a closed double-sided auction.
- Procedure:
  - The solar project should be accredited with the State Nodal Agency 6 months prior to the date of commissioning of the project.
  - The solar project should be registered with the Central Agency 3 months prior to the date of commissioning of the project.
  - The solar generator has to apply to the Central Agency for the RECs based on electricity generated that is certified by the State Load Despatch Centre (SLDC) through a separate meter.
  - Issued RECs can be traded only through power exchanges through a closed double-sided auction.
  - Price of Solar RECs:
    - The price of solar RECs has been fixed within a band of Rs. 9,300 (minimum) and Rs. 13,400 (maximum) per solar REC until FY 2016-17.
- Risks associated with RECs:
  - There are two risks associated with RECs in India.
    - Current market – The market for RECs exist only if RPOs are enforced. The track record of enforcement by most state governments is rather poor. As there is a minimum price at which RECs can be sold, the effect of poor demand is felt in the number of RECs sold: only about 15% of the solar RECs offered for sale in November 2013 found buyers.
    - Future price – The floor price has been set only till 2017. There is uncertainty on pricing beyond this period. Unless enforcement of RPOs improves we expect the price for solar RECs to be in the Rs. 1,500-3,900 range between 2017 and 2022.

Further information on RECs can be found at the REC registration website.

**State schemes**

Several states in India have released solar policies that further incentivise rooftop solar. We provide a brief snapshot of a few state solar policies for rooftops.

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<th>Capacity addition targeted (MW)</th>
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<th>Consumed segment</th>
<th>Project type</th>
<th>Incentives</th>
<th>Offtaker/Power Purchaser</th>
<th>Base requirement</th>
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<tr>
<td>80% Government, 20% Residential</td>
<td>Rent-a-roof</td>
<td>1.- 5 MW rooftop programme on the PPP model in the capital which is now extended to about 5 more cities and towns. 2.- Monthly incentive of Rs 3/kWh for the roof owner</td>
<td>State Distribution Agency</td>
<td>Various sizes of PV systems ranging from 500 kW to 1 kW</td>
</tr>
<tr>
<td>All buildings with rooftop space</td>
<td>Rent-a-roof</td>
<td>1.- Rs 3-4 /kWh. 2Net Metering. 3.- Any other incentives available to rooftop systems</td>
<td>State Distribution Agency</td>
<td>Developers should guarantee a minimum of 450 kWh a year for half kW systems and 900 kWh for 1 kW</td>
</tr>
<tr>
<td>Residential only</td>
<td>Owner-owned</td>
<td>1.- 30% Subsidy from MNRE. 2.- Rs 39000/system from the Government of Kerala</td>
<td>Captive (home use)</td>
<td>Small solar power plants connected at 11 kV of a minimum of 1 MW</td>
</tr>
<tr>
<td>All buildings with rooftop space</td>
<td>Owner-owned/Rent a roof</td>
<td>Tariff-based competitive bidding</td>
<td>State Distribution Agency</td>
<td>Captive and State Distribution Agency</td>
</tr>
<tr>
<td>Residential and Commercial</td>
<td>Owner-owned/Rent a roof</td>
<td></td>
<td>State Distribution Agency</td>
<td></td>
</tr>
</tbody>
</table>

| Tariff-based competitive bidding | 1.- Rs 2/kWh for first two years; Rs 1/kWh for next two years; 0.5 kWh for subsequent two years. 2.- Net metering. 3.- 10000 kW domestic systems eligible for Rs 20000 subsidy in addition to 30% MNRE subsidy | | |

**Table 14. Indian States support schemes**
Several state policies mention net metering. It refers to an incentivising model where excess power generated by the rooftop plant (such as power generated on weekends or national holidays) can be pumped into the grid, and the generator receives a credit for the number of units supplied to the grid against the number of units received from the grid i.e., it is as if the meter ran in reverse when power flowed from the rooftop plant into the grid.

Solar power supplied to the grid under net-metering may not qualify for RECs. For e.g., in Tamil Nadu such power is not eligible for RECs as it is deemed to qualify for the DISCOM’s RPO.

Net metering requires a net meter that can record both power consumed from, and supplied to, the grid. It should be noted that without net metering, the excess power generated is still supplied to the grid. The generator doesn’t receive any benefit from doing so in the absence of a net metering policy

Permissions

Typically, permissions are not required to set up rooftop installations with capacity <10 KW. If the capacity exceeds 10 KW, the main approval required is for the developer to get permission from the nearest substation. Due to the issues of congestion in the grid infrastructure, some local restrictions could be in effect on the capacity of rooftop solar power plants that can be connected to the grid. For e.g., in Tamil Nadu grid connectivity to rooftop solar systems is restricted to 30% of the distribution transformer capacity on a first-come-first-served basis. To avoid any missteps in this regard we urge you to verify with local power distribution authorities if any such restrictions apply to you, irrespective of the size of solar plant you wish to connect to the grid.

Japan

Under the feed-in tariff scheme, if a renewable energy producer requests an electric utility to sign a contract to purchase electricity at a fixed price and for a long-term period guaranteed by the government, the electric utility is obligated to accept this request.

<table>
<thead>
<tr>
<th>Scale kW</th>
<th>Cost (yen/kW)</th>
<th>Pre-tax IRR (%)</th>
<th>FIT Tax exclusive</th>
<th>FIT Tax inclusive</th>
<th>Duration years</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;10</td>
<td>325</td>
<td>10000</td>
<td>6</td>
<td>42</td>
<td>40</td>
</tr>
<tr>
<td>&lt;10</td>
<td>466</td>
<td>4700</td>
<td>3.2</td>
<td>42</td>
<td>42</td>
</tr>
</tbody>
</table>

Table 15. Japan support scheme

(*1) Solar PV power generation using systems for residences

The price for solar PV power generation of less than 10 kW is seemingly the same as that for solar PV power generation of 10 kW or more. However, considering the subsidy of 35,000 yen per kW (FY2012) granted for power generation using systems for residences, the price will be 48 yen in effect

(*3) Treatment of consumption tax

With regard to consumption tax, both the tax-inclusive price and the tax-exclusive price are indicated, assuming that the tax rate may change in the future. However, the tax-inclusive and tax-exclusive prices are the same for the purchase of excess electricity produced from solar PV, which is mostly intended for general consumers.

Certification of FIT Facilities

The facility must be capable of stably and efficiently generating electricity during the guaranteed period. The facility must be capable of transparently and fairly measuring the amount of the electricity produced from renewable energy that is supplied to the electric utility.
The facility to be used for power generation must be specified in detail.

Common standards for all energy sources
- Maintenance system must be secured for the facility.
- The facility must have a structure that is capable of making proper measurements using a measuring instrument.
- The power generation facility must be specified in detail (e.g., the manufacturer and the model code of the product).
- The renewable energy producer must record and periodically submit the breakdown of the costs for installing the facility (the facility cost, the land cost, the cost for access to the electric power system, the maintenance cost, etc.) and the breakdown of annual fiscal costs for operating the system.

Energy source-specific standards
- A solar PV facility of less than 10 kW must have received certification for conformity to JIS product standards or equivalent certification (certification by the Japan Electrical Safety & Environment Technology Laboratories (JET) or equivalent certification by an overseas certification body).
- A solar PV facility of less than 10 kW must have wiring for supplying excess electricity (a wiring structure for first allocating the generated electricity to power consumption within the residence, and then supplying the remaining electricity to the electric utility).
- The following requirements are imposed on the so-called “roof-lending business” (only such business with a total power output of 10 kW or more):
  - Each residence must have wiring for supplying the electricity directly to the electric utility.
  - The roof-lending contract document must be attached.
- When using the following types of solar panels, the power generation efficiency must be those respectively indicated for the following types:
  - Monocrystal or Polycrystal silicon: 13.5% or higher
  - Thin-film semiconductor: 7.0% or higher
  - Compound semiconductor: 8.0% or higher

Time of application of the tariff
The tariff to be adopted is the tariff at the time when the electric utility receives the application form for a contract on access to the electric power system or when the Minister of Economy, Trade and Industry approves the facility, whichever is later.

Time of commencement of the duration
The duration commences at the time of initiation of electricity supply under a specified contract. In the case of new installation or addition/modification to an important part of the facility
When there is any change to an already approved facility, it is necessary to obtain approval for the facility anew.
When the incremental amount of electricity supplied through additional installation or repowering can be clearly measured and this fact can be confirmed by wiring diagram or the like, the incremental output can be made subject to purchase.

Turkey
The support scheme in Turkey is a combination of FiT and local content bonus.
The Renewable Energy Law 6094 has introduced a purchase guarantee of 0.133 USD/kWh for solar electric energy production paid during ten years. In case of the use of local components for the PV system, additional
incentives can be granted:

- PV module installation and mechanical construction, (+0,008 USD/kWh)
- PV modules, (+0,013 USD/kWh)
- PV cells, (+0,035 USD/kWh)
- Inverter, (+0,006 USD/kWh)
- Material focusing solar energy on PV modules, (+0,005 USD/kWh)

Feed-in tariff. Plant operators are entitled against the grid operator to the payment of a fixed feed-in tariff for all electricity exports to the grid. The feed-in tariff varies according to the source of energy used and whether the components of the plants are made in Turkey or not. The feed-in tariff varies according to the energy source and the origin of the plant components. It has to start to be in operation between 18.05.2005 and 31.12.2015.
Duration of the incentive: 10 years.

Mexico
Still pending of the total development of the Energy Reform Legislation, some schemes can already be found.

Accelerated depreciation for PV systems exists at the national level and some local incentives such as in Mexico City.

A net-metering scheme exists for PV systems below 500 kW mainly in the residential and commercial segments. The price of PV electricity for households with high electricity consumption (DAC) is already attractive from an economic point of view since they pay more than twice the price of standard consumers. At the end of 2012, around 1600 customers were using this scheme. Since 2012, this net-metering is also available for multi-family housing, with pre-arranged shares.

A virtual net-metering system exists for large installations, with the possibility to net electricity consumption and production at distant sites.
In December 2012, the National Fund for Energy Savings announced the start of a new financing scheme for PV systems for DAC consumers: 5 year loans with low interest rates can be used to finance PV systems.

Chile
Renewable energy quotas oblige utilities to buy at least 5% of their annual traded electricity from RES but no provision for PV exists as such.
In March 2012 a net-billing regulation was introduced for systems up to 100 kW: PV electricity in excess can be valued at a price lower than the retail price (depending on the conditions, this could be the equivalent of the market price). So far this law hasn’t entered into force and is thus not yet applicable.

Brazil
Tax breaks have been approved on PV systems up to 30 MW in size.
Net-metering exists for systems up to 1 MW. This system allows compensating production and consumption over a period of 36 months. This compensation will be organized by rate periods (peak PV electricity can compensate for peak consumption and in the same way for off-peak production). Net-metering is allowed between distant production and consumption sites if they belong to the same user and take place in the same grid area.
Canada
Ontario’s Feed-in Tariff Program: This is North America’s first comprehensive guaranteed pricing structure for electricity production from RES. The first part targets generators above 10 kW (the “FiT Programme”) while the second part focuses on systems below that limit (“MicroFiT programme”). PV systems can be granted the FiT for a period of 20 years. A particularity of this programme is the imposition of a 60% domestic (Ontario) content policy: This regulation was challenged in front of the WTO that ruled against Ontario in 2012 with a possible appeal in 2013. PV remains a marginal source of electricity in other provinces, although the province of Alberta could be the second to step into PV development.

ONTARIO: Roof M.: 10-100kW CA$0.345/kWh BIPV/Ground-mounted 10-500kW CA$0.288/kWh 20 years
Net Metering, Net billing exists in the rest of states.

Nigeria
NERC has proposed incentives such as a guaranteed market for renewable energy supplies (investment in renewable energy had never been attractive due to the high capital requirements), simplified licensing process, access to land and most importantly a robust feed-in tariff that is enough to allow for operators to recover costs over a period of time.

<table>
<thead>
<tr>
<th>YEAR</th>
<th>FIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>$0.427/kWh</td>
</tr>
<tr>
<td>2013</td>
<td>$0.461/kWh</td>
</tr>
<tr>
<td>2014</td>
<td>$0.497/kWh</td>
</tr>
<tr>
<td>2015</td>
<td>$0.537/kWh</td>
</tr>
<tr>
<td>2016</td>
<td>$0.579/kWh</td>
</tr>
</tbody>
</table>

Table 16. Nigerian support scheme

South Korea
Investment and other subsidies
In 2004, the South Korean government passed the Act on the Promotion of the Development, Use And Diffusion of New And Renewable Energy (the Act). With the goal of becoming one of the five largest producers of new and renewable energy, the government has announced that a total of South Korean won (KRW)40 trillion (EUR25.8 billion, USD34.2 billion) will be invested in renewable energy by 2015. This investment includes KRW22.4 trillion invested by the nation’s 30 largest industrial groups by 2013, KRW7 trillion of government contribution, and KRW10.6 trillion from other private sectors. South Korea has already seen substantial financial investment in renewable energy in recent years, including KRW2 trillion (EUR1.3 billion, USD1.7 billion) from the government in the last two years.

The revision of the Act on the Promotion of the Development, Use And Diffusion of New And Renewable Energy (the 4th) will be issued by the first half year of 2013 and the target is expected to be revised upward from existing target ‘renewable energy supply rate 11 per cent in 2030.

To reach this goal, the government is implementing initiatives in four major areas:

- Strategic R&D and commercialization
- Promotion of industrialization and market creation
- Promotion of exports of new and renewable energy products
- Infrastructure development.
Operating subsidies

**Feed-in tariff**
The feed-in tariff was abrogated at the end of 2011 due to introduction of a renewable portfolio standard (RPS) in 2012. (The government maintains a feed-in tariff only for existing recipients).

To accommodate small renewable energy facilities that could not receive support by RPS, the Seoul Solar Power Plant Support Plan was announced in May 2013. The plan supports operations from the installation of solar power plants to sales for small entities under 50 kW capacity in Seoul. According to the plan, the small entities can receive KRW50/kWh (approximately 10 per cent of installation cost) for five years from 2013.

**Premium**
The R&D tax credit program is applied for renewable energy technologies. Import duties are reduced by 50 per cent for all components and/or equipment used in renewable energy power plants.


The total budget in 2013 is KRW79.2 million, KRW64.2 million from the Special Account, and KRW15 million from the Electricity Fund. The government provides subsidies up to 90 per cent (in the case of conglomerate, 50 per cent) to the approved applicants. Subsidies were set at a variable interest rate (from 1.75 per cent to 2.25 per cent in 2012), including a five-year grace period followed by a 10-year payment period.

**Quota obligation**
In 2012, the existing feed-in tariff was replaced by an RPS that was approved by the government assembly in March 2010.

The RPS requires 13 state-run and private power utilities with a capacity in excess of 500 MW to generate two per cent of the energy production from renewable sources by 2015. This percentage will be increased in stages to 10 per cent by 2022.

In terms of the standard price per certificate, REC for solar power was KRW184,200 averagely in 2012, while REC for non-solar power was determined to be KRW 32,331 regardless of its implementing method.

The total RPS target for 2013 was confirmed as being 9,210,381 MWh; increasing 41 per cent from last year’s target (6,420,279 MWh), while the RPS target for solar power rose 270 per cent from 276,000 MWh to 723,000 MWh in the same period.

**Additional**
One Million Green Homes Project: As a part of the 2009 budget, the government appropriated KRW94.3 billion (USD72 million) for the One Million Green Homes Project. The intent is to build one million homes by 2020 that use one of the following renewable energy technologies: solar thermal, solar photovoltaic, geothermal, biomass and wind energy. Each year, the government will set a new budget for the coming year.

The green homes being built are environment-friendly and use new and renewable energy resources. In addition, green homes create no carbon emissions and use less energy, water and natural resources.

**Other support programs**
The government will support 10 major green projects that have impressive promotional and installation effects.

**Thailand**
The solar power generation target has been increased to 3 GW together with the reopening of the solar PV rooftop VSPP scheme with a new feed-in tariff (100 MW for small rooftops below 10 kW; 100 MW for commercial and industrial rooftops between 10 and 250 kW and large scale rooftops be-tween 250 kW and 1
Solar PV Rooftop Programme: total target of 200 MW; out of this 200 MW, 80 MW are allocated to be installed in three provinces namely Bangkok, Nonthaburi and Samut Prakarn (40 MW of which residential and 40 MW commercial).

FiT prices have been fixed at 6.96 THB per kWh (0.2245 USD per kWh) for residential size, 6.55 THB per kWh (0.2113 USD per kWh) for medium buildings and industrial plants and 6.16 THB per kWh (0.1987 USD per kWh) for large buildings and industrial plants. The FiT will be paid during 25 years.

Installers wanting to set up PV rooftop systems will have to be certified by and registered with the Department of Alternative Energy Development and Efficiency (DEDE) or a person with relevant license for professional practice.

<table>
<thead>
<tr>
<th>Classification</th>
<th>Scale kW</th>
<th>Quota MW</th>
<th>FIT c€/kWh</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential</td>
<td>0-100</td>
<td>100</td>
<td>16.43</td>
</tr>
<tr>
<td>Small and medium commercial</td>
<td>&gt;10-250</td>
<td>100</td>
<td>15.46</td>
</tr>
<tr>
<td>Medium and large commercial/industrial</td>
<td>&gt;250</td>
<td>14.54</td>
<td></td>
</tr>
</tbody>
</table>

Table 17. Thailand support scheme

According to informal discussions with ministry officials, it can be expected that the target of 200 MW could be increased in 2014, possibly with a lower feed-in tariff. The government could support up to 100,000 domestic rooftop systems and 1,000 commercial systems with a total capacity 800 MW. Feed-in tariffs (FITs) – as well as tax breaks and soft loans – are available to support the rooftop policy.

Apart from these two promotion schemes, the Government also approved 25 MW of rooftop PV installations for Government buildings. With these schemes, Thailand aims at continuing the deployment of grid-connected PV in the rooftop segments, after a rapid start in the utility-scale segment.

In addition, the Thai Government also approved the so-called “community solar” power generation scheme of 800 MW. This scheme will be implemented by cooperation between the Ministry of Energy and the National Village and Urban Community Office, under the Prime Ministry Office. The stepwise FiT prices for this scheme will decrease from 9.75 THB per kWh for the first three years, down to 6.5 THB per kWh in the seven following years and finally 4.5 THB per kWh until the 25th year. These 800 MW are planned to be completed by the end of 2014.

Filipinas
During December 2012, the Philippines introduced a FIT rate set at $0.23/kWh and approved a pipeline of approximately 0.5 GW of solar plants.

The solar carve-out within the RPS out to 2015 has been reset to 50 MW.

Vietnam
An avoided cost-based electricity tariff was introduced in Vietnam in 2008. To be eligible for this tariff, a grid-connected renewable energy plant must meet certain criteria, such as having an installed capacity of less than 30MW; complete renewable generation (as opposed to a hybrid system) and the project must use the standardised power purchase agreement for the sale of electricity.

Presently, a feed-in tariff is only available for wind generated power. Despite being widely predicted as a turning point for wind investment when it was introduced in 2011, the tariff has not proven sufficient to entice
much investment as the rate itself is low by regional standards. The Government has introduced a land fee tax exemption and an import tax exemption for renewable energy generators. Investments in small-scale hydropower, wind, solar, geothermal, biomass and biofuels projects receive Government support through PDP 7.

**Colombia**

In May 13rd, the new “Ley 1715 of 2014” has been approved, by which the integration of non-conventional renewable energy to the National Energy System is regulated. The law provides financial support for the deployment of off-grid renewable energy projects across Colombia and aims to reduce the use of diesel fuel in non-interconnected areas by replacing diesel generators with renewable energy installations. Deployment of these installations is being supported by a newly created fund, the Fondo de Energías No Convencionales y Gestión Eficiente de la Energía. The new law also provides a legal framework for the development of renewable energy projects in Colombia. The new law allows Self-consumption with Net-metering, along with a combination of tax cuts for 50% of the investment, tax exclusions, exemption duties payment, and accelerated depreciation of assets.

**Indonesia**

By the end of 2025, the Government of Indonesia has targeted a share of electricity produced from renewables of 25%, with solar at the 0.2-0.3% level, equivalent to 1.0 GW of PV installations. The forthcoming FiTs may accelerate the PV demand in Indonesia, making it the second largest PV market in the Southeast Asia region.

As an incentive to encourage development of solar PV, the GoI has already released regulation (MEMR Regulation Number 17 Year 2013 concerning on Purchasing Electricity From Solar PV Power Plant)

- The tariff levels are based on ceiling price of 25 cent/kWh (using modules with local content < 40%, i.e. considered as imported modules) and 30 cent/kWh (using modules with local content ≥ 40%)
- The application for the ceiling price will be done through bidding process using online system based on certain quota per annum.
- The quotas have already determined by Director General of NRE&EC
- The total of quotas in 2013-2014 is 140 MW, in 80 Locations
- Currently 5 Locations (12 MWp) have appointed investors through bidding process, and 6 Locations on Bidding Process

**Malaysia**

The National Renewable Energy Policy and Action Plan (NREPAP) provides long-term goals and commitment to deploy renewable energy resources in Malaysia. The FiT Programme is funded by a Renewable Energy Fund (RE Fund) funded by electricity consumers via a 1% collection from the consumers’ monthly electricity bills. Small consumers with consumption below 300 kWh per month are exempted from contributing to the fund. Due to the limited amount of the RE Fund, the FiT is designed with a cap for each technology. BIPV installations are incentivized with an additional premium on the top of the Feed-in Tariff.

Solar PV FiT Rates:
Taiwan
The FIT policy framework in Taiwan is mainly based on various program caps, executed through public tenders. Investment returns for the rooftop mount segment are still attractive to project developers. One significant evidence is that the government has revised the annual installation target within year 2013 from 130 MW to 170 MW.

<table>
<thead>
<tr>
<th>RE Installation Capacity</th>
<th>FIT Rate (RM/kWh)</th>
<th>Effective Period</th>
<th>Yearly Degression</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 4kWp installed capacity</td>
<td>1.23</td>
<td>21 years</td>
<td>8%</td>
</tr>
<tr>
<td>Above 4kWp up to 24kWp</td>
<td>1.2</td>
<td>21 years</td>
<td>8%</td>
</tr>
<tr>
<td>Above 24kWp up to 72kWp</td>
<td>1.18</td>
<td>21 years</td>
<td>8%</td>
</tr>
<tr>
<td>Above 72kWp up to 1MWp</td>
<td>1.14</td>
<td>21 years</td>
<td>8%</td>
</tr>
<tr>
<td>Above 1MWp up to 10MWp</td>
<td>0.95</td>
<td>21 years</td>
<td>8%</td>
</tr>
<tr>
<td>Above 10MWp up to 30MWp</td>
<td>0.85</td>
<td>21 years</td>
<td>8%</td>
</tr>
<tr>
<td>Additional if installed in building structures</td>
<td>0.26</td>
<td>21 years</td>
<td>8%</td>
</tr>
<tr>
<td>Additional for using building materials</td>
<td>0.25</td>
<td>21 years</td>
<td>8%</td>
</tr>
<tr>
<td>Additional for using assembled Solar PV modules</td>
<td>0.03</td>
<td>21 years</td>
<td>8%</td>
</tr>
<tr>
<td>Additional for using assembled Solar inverters</td>
<td>0.01</td>
<td>21 years</td>
<td>8%</td>
</tr>
</tbody>
</table>

Table 18. Malaysia support scheme

Support schemes in Europe and prospects for PV
This table provides an overview of the support framework status in the most relevant European markets in early 2014.

<table>
<thead>
<tr>
<th>RE Category</th>
<th>Type</th>
<th>Scale (kW)</th>
<th>FIT (USD/kWh) 2013</th>
<th>FIT (USD/kWh) 2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roof</td>
<td>1-10</td>
<td>0.285 (0.277)</td>
<td>0.243</td>
<td></td>
</tr>
<tr>
<td></td>
<td>10-100</td>
<td>0.256 (0.248)</td>
<td>0.218</td>
<td></td>
</tr>
<tr>
<td></td>
<td>100-500</td>
<td>0.241 (0.234)</td>
<td>0.205</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&lt;500</td>
<td>0.215 (0.203)</td>
<td>0.177</td>
<td></td>
</tr>
<tr>
<td>Surface</td>
<td>&gt;1</td>
<td>0.203 (0.191)</td>
<td>0.167</td>
<td></td>
</tr>
</tbody>
</table>

Table 19. Taiwan support scheme

---

<table>
<thead>
<tr>
<th>Country</th>
<th>Political support environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Belgium</td>
<td>Reduced support to PV for all segments. Streamlined administrative processes. Grid tariff cancelled in Flanders but</td>
</tr>
<tr>
<td>Bulgaria</td>
<td>Very unstable environment. Retroactive grid fees revoked and re-established. Incentives for residential and commercial</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>Reduced tax but environment still hostile to rapid PV deployment. FIT no longer available for PV systems. New legislation</td>
</tr>
<tr>
<td>France</td>
<td>Clear FIT evolution in 2014. Slow administrative process still in place. FIT bonus for local content no longer available.</td>
</tr>
<tr>
<td>Germany</td>
<td>Clear FIT evolution in 2014, but really low return on investment. Simple and lean administrative process. Risk of grid tariff imposition</td>
</tr>
<tr>
<td>Greece</td>
<td>Clear FIT evolution in 2014. Adverse financial environment limiting development of new projects. Residential PV favoured</td>
</tr>
<tr>
<td>Italy</td>
<td>No FIT available but some direct incentives. Possibility of large-scale PV development due to new support schemes</td>
</tr>
<tr>
<td>Netherlands</td>
<td>Net-metering and high electricity prices allowing for a residential market to develop rapidly together with an investment grant.</td>
</tr>
<tr>
<td>Poland</td>
<td>New FIT and green certificate scheme under discussion for over two years, no adoption foreseen before beginning 2015.</td>
</tr>
<tr>
<td>Portugal</td>
<td>Drastic changes in the FIT schemes affecting small-scale PV development. Large-scale development still slow due to</td>
</tr>
<tr>
<td>Romania</td>
<td>Drastic reduction of the number of green certificates limiting the market growth.</td>
</tr>
<tr>
<td>Spain</td>
<td>Support to PV frozen since 2012 and any new development blocked for several reasons (overcapacity, tariff deficit, etc.). Heavy and slow administrative processes. Many attempts to revitalise the utility-scale segment without incentives, but no significant development so far. Risk of grid tariff imposition</td>
</tr>
<tr>
<td>Switzerland</td>
<td>Clear FIT evolution in 2014 for large systems. Self-consumption now allowed for residential sector. Long waiting list</td>
</tr>
<tr>
<td>Turkey</td>
<td>Net-metering scheme for systems up to 500 kW. Administrative process unclear.</td>
</tr>
</tbody>
</table>

*Table 20. Europe support scheme by country*
9 Conclusions

9.1 ETFE-MFM BIPV element

- Qatar is the mid-term most suited market to ETFE-MFM element.
- China, India, U.S., Japan and some Asian countries look promising markets in mid-long term.
- The future market for ETFE-MFM element, taking into account construction forecast, DGP growth forecast and PV market forecast, is far from OCDE countries.
- As soon as ETFE-MFM is able to standardize its use to housing construction element, (beside its particular emblematic building application), its future market looks pretty promising, since the demographic pressure in emerging countries, along with increasingly wealthy citizens desiring largely number of new homes each year will demand a huge amount of new houses in mid-term.
- Emerging countries will play the role of economic drivers in next decades. Such countries have missed strong PV policies and mature PV markets, but are rapidly joining to existing ones, and can take advantage of European/US experience in that sense.
- Energy needs due to demographic pressure will boost PV solutions in that regions.
- Need of considering the ETFE-MFM product as a (rather than architectural) mainly photovoltaic product in order to take advantage of PV support schemes (certain tax benefits, exemption from duties, etc.), and thus accelerate its ROI.
- For an accurate calculation of LCoE for ETFE-MFM element, replaced standard construction materials and easiness of mounting has to be considered in the equation.
- Both the LCoE of PV and the subsidies required are almost as sensitive to differences in the cost of capital as they are to differences in the quality of the solar resource.
- Policies to make capital for ETFE-MFM investment more competitive could take the place of PV subsidies as a means of stimulating market growth. The capital costs seem to play a key role for PV investments. In those countries with high capital cost figures, special support schemes have to be put in play. Risk country and investment return should be guaranteed in promising economic growing regions.

9.2 Support mechanisms

From the analysis from previous chapters, it is clear that the evolution of the PV market has been closely associated with the programs and policies to encourage photovoltaic technology promoted by the various countries.
It can be guessed that there is no "magic formula" to achieve sustainable growth of the PV market, and that sustainability can only be achieved with a balanced mix of incentive mechanisms (tariff and financial), reasonable administrative procedures and facilities connection to the network facilities.

- Although ETFE-MFM product has been ideated just to cover the power demand of the LED lighting array, not only an off-grid system with batteries is possible for a façade built with it: power consumption and injection into the grid would be viable if supply shortage or over-production, respectively, exists and the local administration allows the net connection. It would be indispensable indeed in absence of batteries, since an auxiliary electrical system would be necessary in order to guaranty power supply. In this regard, it is convenient to know the different policies of incentives and taxes, depending of the modality of the grid connection and BIPV legalization.

- It can be concluded, however, the experience of the countries analysed, the incentive mechanism of "feed-in-tariff" type have proven to be the most effective for the development of PV markets, besides not represent burden for national budgets, as they are funded by all electricity consumers.

- The experience curve from mature markets shows that incentive mechanisms have evolved from the direct financing of facilities to ratemaking type "feed-in-tariff" subsidies, for which electricity is produced by rewards facilities at regulated prices that distinguish between the location of buildings and facilities on ground.

- With the scope of the competitive period for photovoltaic technology, the incentive should be changed (not deleted) as it is a form of recognizing and valuing the maximum use of electricity positive in the place where it is consumed.

- It is necessary that prices of commercial electricity reflect proper form generation costs, for example by varying rates on an hourly basis, as is expected to happen in the EU in the short-medium term. In this context, it may be appropriate for certain mechanisms of "feed-in-premium" type for certain markets or segments in which the Internal Return on investment in photovoltaic Rates not reach values considered sustainable.

- Some countries specify rates for different degrees photovoltaic BIPV and specify eligibility criteria for each case. With this, aims to encourage the PV industry specialization in components for architectural integration overlooking the domestic market and for export. Some others have established rates photovoltaic "feed-in-premium" type incentives for architectural building integration, with the different types defined for specific integration requirements. These rates also may increase in combination with performance and energy efficiency savings held in buildings.

- In post incentive era, self-consumption along with "net-metering" schemes could boost the PV rooftop integration.

- Very interesting appears the US market, where new business models associated to PV market (rented roofs, third parties, financing schemes, private buy-sell agreements electricity produced by large photovoltaic systems ("Power Purchase Agreements").

- Due to the impressive drop down on cost in PV installations, grid parity has been achieved in many regions around the world.