GLOBAL CUMULATIVE INSTALLED PHOTOVOLTAIC CAPACITY AND RESPECTIVE INTERNATIONAL TRADE FLOWS

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Motivation & Purpose of Work
The installed capacity of photovoltaic (PV) is rising steadily. Most PV is installed in highly electrified countries as on-grid applications. Further there are reams of small off-grid systems in rural areas of developing countries. Due to this, reliable installation rates for PV are available only for a limited number of countries. About 2,000 MWp cannot be allocated to any country. An overview on installed PV for all countries in the world is provided, enhancing a better understanding of PV diffusion.

Detailed PV installation dataset is available for public dissemination (pls. provide business card).

Global PV Installations

Regional Distribution of PV

Fig. 2: Total installed PV capacity per country by end of 2010
• world’s total installed PV capacity allocated to 38,534 MWp in the end of 2010 on a per country basis
• further 487 MWp expected to be installed before 2000
• PV installations to be found in almost all countries
• seven largest markets comprise 87% of global PV installations
• plenty of developing countries with significant installed PV base, mainly representing high diffusion of small off-grid applications being used for electrification of remote areas
• e.g. 5 MWp solar home systems with an average size of 50 Wp represent a solar power solution for 100,000 families

PV Market Growth in 2010

Fig. 6: Ratio of added PV capacity in 2010 to cumulative PV installations in 2009 by growth categories.
• few countries have reached huge growth rates in 2010
• several European PV markets have more than doubled (Czech Republic, Romania, Greece, Bulgaria, UK, France, Belgium), whereas German market grew by 78%, and others grew not more than 10% (e.g. Spain, Finland)
• East Asian PV markets show growth rates about 40%-50%
• South East Asian markets are boosted by growth rates higher than 100%, e.g. Australia, Philippines, China, Cambodia, Vietnam, Myanmar, Mongolia, Singapore
• African markets grew substantially across the continent
• Americas are quite different
• enormous growth by about 200% and higher, e.g. Uruguay, Guyana, Peru, Costa Rica and Canada
• slow to zero growth, e.g. Venezuela, Mexico and Bolivia
• in total the majority of PV markets grew by more than 50% and more than 50% of the growth was by more than 100%

Examination Method
Examination relying on public accessible data
• basic source: international customs database, monitored by ‘Market Analysis and Research’ section of the International Trade Centre (agency of UN’s WTO) [1]
• contains customs data of 188 countries worldwide since 2000 (total value of imported and exported products for each country per year)
• products classified in several specific product numbers, so-called HS Codes
• HS Code group 854140 represents PV, i.e. solar cells, solar modules, etc.
• it is valid, that ‘imports A from B’ = ‘exports B to A’
• possibility of cross-checking to increase data reliability
• PV capacities per country calculated: ‘import A’ = ‘exports A’ + ‘production A’ = ‘market A’
• 20% of annual productions installed in the following year
• further sources: installation and production rates estimated by EPIA, IEA-PVPS, GIZ and Photon [2-6], as well as insights of local PV experts

Assumptions for the Analysis
Fig. 1: PV price for conversion of customs values into PV capacity [7]. Abbrev. stand for: North (NA) and Latin America (LA).
• costs data include monetary value of installed products
• conversion to PV capacities is necessary
• price data refer to a worldwide annual average PV price [7]
• prices depend on countries’ locations and market sizes
• significant range of diverging between countries
• classification of all countries that are nearly comparable in market size and economic conditions in five main groups (one of them having two subgroups)
• price of each group multiplied by experience ratio to average worldwide price +10% for shipping and distributor margin

High Input in Off-Grid Countries

Fig. 4: Global overview on cumulative PV installations per million USD of GDP by end 2010.
• few countries invest considerable fractions of their economic power in PV (Germany, Spain, Czech Rep., Japan, Italy, etc.)
• several developing countries invest more of their GDP in PV than most of highly developed countries (e.g. the US)
• recognizable in installed PV per economic power
• off-grid PV markets mainly driven by fast amortization of PV systems in rural areas of developing countries [9]
• those markets have no need for subsidies

PV Markets

sample of markets’ PV capacities by end of 2010:

<table>
<thead>
<tr>
<th>country</th>
<th>PV (MWp)</th>
<th>country</th>
<th>PV (MWp)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Germany</td>
<td>7,210</td>
<td>Portugal</td>
<td>720</td>
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<tr>
<td>Spain</td>
<td>2,940</td>
<td>Austria</td>
<td>290</td>
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<tr>
<td>Italy</td>
<td>4,940</td>
<td>Netherlands</td>
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<td>France</td>
<td>1,700</td>
<td>Czech Republic</td>
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<td>China</td>
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<td>Brazil</td>
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<tr>
<td>India</td>
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<tr>
<td>Slovenia</td>
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<td>Finland</td>
<td>25</td>
</tr>
</tbody>
</table>

Conclusion

• 38,534 MWp allocated to 190 countries
• not allocatable PV capacity (‘Rest-of-World’) has been reduced by about 1,000 MWp
• analysis of ITC customs data for the years 2001 - 2010 enables an allocation of 120 MWp in 88 countries of no other data source
• insights of local experts and examination of reports complement all other data
• 487 MWp assumed to be installed before 2001 being not allocatable by the customs approach
• further 512 MWp expected to be installed in 2001 - 2010 but cannot be allocated
• some countries invest high rates of their economic power in PV
• off-grid PV markets have typically no need for subsidies but respective countries reached high share of PV in total power plant capacities
• the majority of countries in the world show a growth rate of more than 50% and 50 countries grew by more than 100% from 2009 to 2010

Detailed data for 190 countries available in Conference Paper. Please provide your business card for further information.

References
[4] EPIA 2010,Latin and South America, Brussels
[6] Breyer Ch et al., 2010, Research and Development Investments in PV – A Leading Factor for a Fast Diffusion?, 29th EU-PVSEC, Valencia