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Information note on Subsidies for Renewable Energy Technologies under SREP

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I. Summary and operational implications

I. 1. Objectives of the note

The objective of this guidance note is to support the efficient and effective use of SREP funds. The note does so by reviewing different subsidy mechanisms used in developing and developed countries, and providing guidelines for development and application in SREP investment plans. SREP projects and associated subsidies will not be implemented in a policy vacuum. They will face effects of numerous pre-existing national subsidies that will work both in favour and against the development of renewable energy sources.

This note complements SREP Financing Modalities note and the paper on financing mechanisms. It does not provide specific guidelines how to design SREP projects. Instead it provides an overview of issues that SREP missions may want to consider in the wider policy environment for renewable energy in the pilot countries. The main idea is to provide guidance on how SREP should deal with existing subsidies, e.g. by declining involvement or proposing policy conditionality.

This will not determine but can inform how SREP itself designs and tailors its financial products. The limited size and timeline of SREP will constrain the systemic impact that it may have in the countries of operation. However, it is also expected that SREP will have a strong catalytic impact both by leveraging much larger private and MDB finance and by fostering transformational changes in the sector. Therefore, SREP managers need to understand the complex impacts of existing subsidies and design SREP products accordingly to foster a wider systemic transformation in the low income countries towards the sustainable enabling environment for renewable generation investments.

I. 2. Justification and targeting of subsidies in SREP investment plans

Justification of subsidies in the SREP investment plans should clearly distinguish arguments justifying government intervention in general from arguments justifying subsidies, as a specific form of government intervention.

- The most solid justification for subsidizing renewable energy above the carbon price is support for nascent industry with the potential for significant cost reduction in future (learning effect).
- Subsidies can also be instrumental for the development of innovative business lines and financial products by the financial institutions especially in the riskier environments.
- In some circumstances subsidies can be temporary substitutes for other policy failures (e.g. failure to price full cost of conventional energy), but only if they are linked to the concrete steps to phase out existing countervailing subsidies to fossil fuels and gradual introduction of carbon pricing (through carbon trading or tax mechanisms). SREP investment plans will verify progress and programs towards full-cost pricing of fossil fuels and design SREP support accordingly.
- SREP investment plans will also analyse wider economic risks of subsidising renewable energy, such as impact on grid stability, affordability to consumers and fiscal capacity to provide investment and operational subsidies in order to mitigate regulatory risks associated with unsustainable support measures.
- Whenever support for less mature technologies is argued on the grounds of development of the domestic manufacturing or assembly base these claims will be critically assessed and conservative, realistic approach will be taken.

I.3. Subsidising fishing rods (capacity building) and fish (deployment)

SREP subsidies for technical assistance and capacity building would support sustainable policy and market reforms and creation of enabling institutional framework for commercially driven renewable investments. Where possible, SREP funding for capacity building should be linked to investments and address specific market and institutional barriers that can not be tackled by investment financing. Investment subsidies should in principle not substitute for actions necessary to correct regulatory and policy failures.

- At the government level this can include financing least-cost generation studies, strategic environmental impact assessments of wind and small hydro, grid-integration measures, such as grid codes, market and tendering rules facilitating competitive entry of renewable IPPs, analysis of integration of RE into rural electrification plans, streamlining licensing and permitting, etc.
- Technical assistance to financial and technical intermediaries (banks, energy service companies) can facilitate transfer of know-how to entities that could become aggregators and developers of small scale renewable technologies.
- Technical assistance at a project level: can involve project preparation and verification or development of carbon finance documents necessary to access carbon markets.

Deployment subsidies will support investments directly

- It would be prudent to focus SREP subsidies on mature renewable technologies that are cost-effective in national context (small hydro, waste-based biomass, wind, off-grid competitive renewable technologies) and provide access to cheap, reliable energy. For such mature renewable technologies SREP subsidies would facilitate deployment that can reduce costs due to scale effect.

- SREP is in principle open to different renewable technologies. Merits of technology neutral support would be considered in investment plans even if a government requests funding for specific technology or if national support policies favour certain technologies more than others. Undistorted choice of technologies and sites by developers, subject to performance requirements and legal constraints, can provide valuable information which technologies are most cost-effective and appropriate in a country or community context given natural endowments, load profile and risk profile.
- Subsidies for less mature/more costly technologies will be carefully assessed on case by case basis for their potential in specific niches e.g. off-grid applications. Impact on consumer prices and on fiscal space will be carefully analyzed. In some cases SREP investment plan may advise a developing country to postpone deployment of immature, still expensive technologies with steep learning curves (e.g. solar PVs or CPS) until their costs decrease due to R&D and deployment subsidies paid by developed countries.
- For grid-connected technologies a challenge will be to choose a size of subsidy that attract investors and does not back-load consumers or budgets with legacy of maintaining expensive technologies that deliver relatively little energy. Unnecessarily high cost of renewable energy can undermine public support
- Blending SREP subsidies with pre-existing national subsidies should have compelling and clear justification using arguments presented above. Funding gap method could be used to determine level of additional subsidy that would trigger investment without creating windfall profits for the project owners. Merits for blending of subsidies are stronger if they are targeted at different barriers.

I.4. "Smart" subsidy structures

Structuring SREP subsidies will often involve second best choices given imperfect market realities in SREP countries. However, the structure should not lock the country into the burdensome subsidy schemes that would prevent transition to the first-best solutions in mid-to-long term.

Therefore subsidies must be structured in a 'smart' way to support sustainable renewable energy development in the long term. The following checklist can be used to determine if a subsidy is smart:

- Are effective in deploying projects on the ground:
- Are precisely targeted at the specific market failure or the barrier, which can not be removed by market conforming interventions alone (for example by removal of fossil fuel subsidies, providing information, or by reducing investment risk);
- Increase the overall volume of finance available for renewable energy investments through high leverage of private and MDB financing;
- Are linked to results and performance such as volume of green electricity and related emissions reduction, rather than to technology cost;
- Provide incentives to maximise annual production rather than installed capacity;
- Do not create permanent risk-adjusted windfall profits, although some windfall profits are necessary to attract primary movers to nascent risky industry

- Have predictable phase-out schedule and the support rates declining over time in order not to create addictive subsidy expectations;
- Are strictly additional - market sounding must show that without subsidies investors are not willing to make economically rational RES investments and commercial financing is not available.

I.5. Forms of subsidy

- There is no a priori advantage of using one form of investment subsidy or another such as grant or loan. There are no clear-cut arguments for using grants for public sector and loans for private sector projects. Both can include the same subsidy component.
- The choice of a particular form of subsidy should always follow market sounding and be tailored to context specific and precise definition of financing barriers to be addressed – in terms of access, cost, risk, or cash-flow profile.
- Concessional loans tend to crowd out private lending both from public and private sector projects. Therefore they will be offered following determination of financial additionality and will be carefully structured not to distort financial market.
- Where possible, priority will be given to commercial finance leveraged by SREP if necessary with matching investment grants or risk management instruments depending on the financial barriers.
- Using SREP subsidies to share the risk with commercial financial intermediaries on the portfolio of their renewable projects (e.g. on a first-loss basis) can leverage significant affordable funding for smaller, decentralized renewable technologies.
- Since SREP has a finite amount of resources and limited lifespan, it may not be able to subsidize operational costs over the lifetime of the project, such as feed-in tariffs or green certificates, even if it proved to be the most appropriate form of subsidy.

I.6. Integration with electricity market

SREP subsidies should be compatible with the sustainable market forces**.** Many SREP countries do not have wholesale electricity markets with competitive generators and suppliers buying and selling power on a transparent platform under the supervision of independent regulator and technical management of system operator. Instead the power systems are dominated by state owned heavily subsidised non-transparent vertically integrated utilities. Such systems naturally have higher barriers to entry of independent power producers (IPPs) and small distributed energy generation. They are usually less successful in ensuring electricity access, quality of service and attracting investments, although this may be the most rational sector model in the small isolated island states, such as State Electric Company Ltd (STELCO) in Maldives.

SREP would focus its subsidies on bringing independent private producers to on- and off-grid generation in a competitive, non-discriminatory manner through transparent tendering or competitive entry to the electricity market if it exists. Subsidising RE investments by state owned monopolistic incumbents may be considered on case by case basis if investment plans demonstrates that competitive generation is not possible or not rational in terms of geographical segmentation, scale of the system or grave security/reliability considerations. Subsidising monopolistic incumbents would always be linked with sector reforms such as unbundling, commercialisation, transparency, non-discriminatory access to grid for renewable energy sources. Without linking to underlying market reforms RE outcomes may not be sustainable. As appropriate on case by case basis the SREP financing should be integrated into the wider renewable energy market reforms, including as many as possible of the following elements:

- Gradual removal of subsidies along the energy value chain, in particular to fossil fuel-based energy;
- Gradual phasing-in of cost recovery tariffs and/or market-based pricing of wholesale energy;
- Unbundling and transition to wholesale electricity market and commercialization/corporatization of all segments in the value chain. In generation, the transition may be done in steps possibly through independent single buyer, pool model and opening for competitive entry of IPPs;
- Integration of renewables into the grid: clear rules for access and allocation of connection costs, changing the rules of transmission and distribution management (grid codes) from top-down planning to reactive approach and smart, bi-directional grids allowing small distributed generation;
- Gradual phasing-in of economy wide carbon price;
- Facilitating integration of renewable energy into the emerging competitive electricity (and capacity) markets, aiming to increase the overall flexibility of power systems so that they can better handle increasing share of relatively small, dispersed and intermittent generation. This includes providing flexible balancing solutions, such as flexible generation (e.g. hydro, gas), load management, energy storage, demand side participation and interconnections with other markets. Electricity market design that facilitates renewable integration includes, low transaction costs for new independent entrants, spot markets with short gate closures, well functioning markets for balancing and ancillary services.
- Eventually gradual phasing-out of renewable subsidies.

The full long run cost of generation including the costs of support for renewable energy (net of donor grants) should be borne by final consumers, and their allocation should be fully transparent, ideally in proportion to their final energy consumption irrespective of source. Careful assessment of fiscal sustainability and behaviours incentives will be conducted if the cost of SREP funds (e.g. debt service) or national subsidy schemes fall on taxpayers.

SREP subsidies should be structured to encourage rather than delay or prevent sustainable and market compatible policy responses that address the root-causes of market failures and barriers to renewable energy. Public funds cannot and should not substitute for weak energy and environmental policies; they should strengthen and not displace more sustainable administrative or economic instruments.[1] RES support should be part of the mid-term program of sustainable low-carbon energy development.

II. Objective and scope of the note

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The scope of the note focuses on grid connected electricity from renewable sources. It also covers mini-grid and off-grid RE electricity. Renewable energy sources such as large hydro or biofuels for transport are beyond the scope of the note. We also do not cover renewable heat only sources.

The SREP Financing Modalities document is structured along two lines: financing modalities for public investments and private sector modalities. This guidance note on subsidies does not follow the same structure. The same principles govern the application of subsidies and other support measures to renewable energy whether plants are developed by the government agencies or the private sector. Except for large hydropower plants that have systemic importance for the balancing of the small power systems, there is not any *a priori* advantage for renewable energy sources to be developed and operated by governments. On the contrary any plant a government agency can do, can also (and usually better) be developed by a private firm under the power supply contract with private or state-controlled buyers. If private developers of renewable energy face barriers to entry, the better response is to address these barriers rather than to subsidize public investments in the sector. This in itself is a barrier to entry to private firms.

III. Background

<u>What is a subsidy?</u>

Over 100 countries around the world support renewable energy producers in various ways.[2] In economic sense any support measure represents a subsidy if it favours renewable energy generators compared to other energy producers. For the purpose of this note we will use this broad concept of a subsidy.

The subsidy component in renewable support policies equals the difference between the prices/costs born by producers/consumers of energy produced from renewable sources and the market value of this energy.

Climate mitigation and development objectives in subsidy programs

In most cases the SREP stated objective to "increase energy access through the use of renewable energy" will be fully compatible with wider development objectives of poverty alleviation and scaling access to electricity. Most literature focuses on synergies between renewable energy and development. From the financing perspective, however, sometimes tensions can grow between SREP and development objectives:

- In certain circumstances – at least in a short term – conventional thermal electricity generation can reduce poverty and increase access to electricity more effectively and efficiently than renewable energy sources because it is still cheaper to consumers in most grid-based applications. Sometimes fossil fuels are also more convenient and reliable in off-grid applications.

- Tension can grow between low-carbon and social objectives in community-based projects. For example in Nepal and Pakistan micro-hydro World Bank projects were designed among others to facilitate social cohesion within traditional small communities. This led to the design of the micro-hydro plants and their mode of operation that was suboptimal from the economic and technical perspective leading to short lifetime of equipment (about 10 years), and rationing of electricity use even when capacity was underutilized. Rules have changed when carbon finance (under CDM) was attracted to enable scaling up penetration and useful services of these plants. Development and operation was taken over by specialised companies who knew how to improve design of the plants for example by purchasing stainless steel blades for turbines. They were also interested in improving operation efficiency for example by maximising capacity utilization to increase power consumption (linked to carbon credit revenues) and by introduction of pay per use system. These changes disrupted traditional decision making and control rules exercised by local village leaders.[3]

SREP would aim to use concessional financing to bridge the gaps between the traditional short term and low-carbon – long-term development objectives in the energy sector. The focus in the project design would be energy access and climate mitigation benefits while subsidy elements could be structured to compensate poor and vulnerable communities for foregone short term development aspirations.

Overlapping subsidies

In several countries SREP concessional funding will encounter various pre-existing support measures. When the subsidies embedded in SREP funding and pre-existing national subsidies interfere with one another the basic principles included in the SREP Financing Modalities paper (see box 1) will apply in the preparation of an investment plan. The structure of SREP financial products can either improve national support schemes or petrify their perverse features.

BOX 1: BASIC PRINCIPLES OF THE SREP FINANCING MODALITIES

- Not to overlap or duplicate concessional financing that is available from other sources such as bilateral donors, other development partners or GEF grants (paragraph 34).
- SREP financing will not be uniformly offered to all private sector companies but will be tailored to address the specific barriers identified in each project and intervention (paragraph 46).
- *Minimum concessionality.* MDBs will seek to provide the minimum concessionality needed to catalyze investments within a sector (paragraph 49).
- *Avoiding distortion and crowding out.* SREP funds will seek to avoid market distortion and crowding out of the private sector. SREP funds will not be priced or structured to displace commercial financing or to set unsustainable expectations in a market. SREP funds will be used to "crowd in" the private sector. (paragraph 50).
- *Leverage*: SREP funds will seek to catalyze and maximize the amount of MDB and other partners' financing as well as commercial financing available for its investments (paragraph 51).
- *Financial Sustainability*: SREP programs will be developed to maximize the probability of long-term financial sustainability once the SREP funds are no longer available/have been used (paragraph 52).

Comparing subsidies: forms and intensity

Subsidies come dressed up in many different types and forms, such as

- direct operational subsidies (e.g. feed-in tariffs);
- indirect operational subsidies (e.g. renewable portfolio standards, green certificates, waiver of balancing charges, guaranteed off-take, priority access to grid/dispatch, or waiver of taxes);
- direct investment subsidies (e.g. grants, concessional loans and equity, or waiver of connection charges);
- Indirect investment subsidies (public loan guarantees, investment tax incentives, or land cost allowances).

Different support measures include different intensities of subsidy component (or different levels of concessionality) irrespective of its form. Different forms of subsidy can have the same value to beneficiary. In order to make different subsidy instruments comparable, their grant or feed-in tariff equivalent can be calculated (see Annex I).

Subsidies to renewable energy versus subsidies to fossil fuels

While IEA, OECD, IMF, and the World Bank have at various times evaluated consumer subsidies to energy (and more often just to fossil fuels),[4] there are relatively few global reviews of subsidies to both the consumer and producer sides.

Global subsidies to fossil fuels significantly outweigh subsidies to renewable energy sources in absolute dollar terms. According to Bloomberg New Energy Finance, consumers and taxpayers of the world provided approximately $43-46bn to renewable energy and biofuels technologies, projects, and companies in 2009. This total includes the cost of feed-in tariffs (FiTs), renewable energy credits or certificates (RECs), tax credits, cash grants, and other direct subsidies. The $43-46bn figure stands in stark contrast to the $557bn spent on subsidizing fossil fuels in 2008, as estimated by the International Energy Agency.[5]

The Global Subsidy Initiative found similar proportions in absolute dollar terms. However, when GSI divided the total subsidy estimate by the quantity of energy produced, the average subsidy per unit of produced renewable energy were over six times higher than support for a unit of fossil fuels based energy and three times more generous than subsidies for nuclear power.[6] The reason is that share of renewable energy in total energy production is lower than their slice in the total subsidy pie.

Table 1: Estimates of Relative Subsidies to Energy Sources

Energy type	**Subsidy estimate (US$ billion/year)**	**Energy produced (2007)**	**Subsidies per energy unit (US cents/kWh)**
Nuclear energy	45	2,719 TWh el.	1.7
Renewable energy (excluding hydroelectricity)	27	534 TWh el.	5.0
Biofuels	20	34 Mtoe	5.1
Fossil fuels (non-OECD consumers)	400	4,172 Mtoe	0.8

Source: The Global Subsidies Initiative, Relative Subsidies to Energy Sources: GSI Estimates, April 2010

The figures in table 1 should be interpreted with care:

- Negative externalities associated with fossil fuel and nuclear energy should be added as implicit subsidies. Back of the envelope calculation suggests that taking carbon price alone of €20/tCO2e would reduce the gap by 30-40 percent (at 750kg CO2/MWh for weighted average fossil fuel plant and exchange rate 1.35 USD/€).
- The data does not capture the full value of subsidy for fossil fuels used for generation of electricity, because it does not take into account conversion efficiency from heat to electricity.[7] The scale of bias in table 1 figures depends on the share of fossil fuels converted to electricity for final consumption. The bias is smaller if substantial portions of the fuel supply is used directly in transport (petroleum) or in space and water heating and cooking (coal, natural gas of fuel oil).[8]

Adding subsidies to large hydro plants could change the gap either way[9]. On the one hand large hydro seems to be a cost effective renewable technology due to scale effect. On the other – government involvement in every aspect of the large scale hydro projects worldwide is common, but data – particularly for the older projects – on public support often scarce even in the most advanced countries.

High level of aggregation masks possibly large differences within each category. Traditionally, natural gas has been far less heavily subsidized than coal or oil. Thus, aggregating all fossil energy hides important distinctions between fuel resources, and loses emerging subsidies to high-carbon synthetic fuel processes entirely. So too with renewable energy sources – PV and CSP tend to be much more heavily subsidized than wind or small hydro. Subsidies to waste-to-energy plants and landfill gas recovery projects are common in the many countries, and often flagged as support for renewable energy. [10]

Notwithstanding shortcomings of GSI comparison of subsidies it sends an important warning signal that renewable energy is on average already heavily subsidised and that massive scaling up of renewable power in national energy portfolios may not be challenging to consumers or taxpayers without rapid reduction in costs of generation. We discuss it further in the section on cost-effectiveness.

IV. Justification for the use of subsidies for RES

Public and private perspectives on subsidies

Investors and governments in renewable energy projects have different perspectives on the rationale for the use of subsidies.

- ***Investors*** are primarily concerned about the adequate relations between returns and risks to their investments. Subsidies represent gains to investors, and generally the higher the subsidies the better it is for investors unless high transaction costs have to be paid.

- ***Governments ands IFIs*** should normally consider many more variables in the subsidy decisions, including the value of alternative goods and services forgone to society when scarce public funds are used to support renewable energy. From the point of view of the government subsidies are transfers between different groups in the society. Public actors are interested in overall low system cost, grid stability, security/reliability of supply, wider social and economic impacts. Therefore the governments and IFIs use subsidies to achieve comprehensive policy goals with the least burden to consumers and/or taxpayers.

Contrary to economic theory, national governments often have a short-term perspective framed by the political cycles, and do not favour policies with long-term benefits at the expense of higher short-term costs. The role of independent sector regulator is to ensure long term security of supply through adequate investments with long term time horizon. Investors also discount the value of long term benefits – especially if risks are high – but often are willing to wait longer for returns than politicians. Utilities typically have 25-30 years investment perspective. The value added of IFIs is to extend the decision making horizon to a very long term, stretching to 40 years of maturities of IDA loans, or even to the lifetimes of multiple future generations for grants and policy advice.

Justifications for the use of subsidy

Governments justify public support to renewable energy using various arguments. The key arguments used in public debates include:

- Externality: level the playing field with polluting incumbents;
- Support nascent industry to reduce costs (learning effect);
- Job creation;
- Removal of non-market barriers to investments;
- Overcoming entrenched behaviour;
- Energy security, mitigating fuel price volatility;
- Equity and affordability.

We briefly describe them below discussing merits of each argument.

- ***Externality***
  Pros: Support for renewable energy is often perceived as an antidote to remaining perverse subsidies to fossil fuel and nuclear-based energy sources. Many argue that it levels the playing field between renewables and highly polluting incumbents that has historically enjoyed various forms of government support. Subsidies can also compensate for the failure of the market to monetize global and local benefits of emissions reduction if renewable energy displaces pollution intensive energy.
  Cons: The first best and sustainable solution to the problem of externality is to charge polluters, rather than to subsidize renewable generation. Adding subsidies to renewable energy without cutting existing subsidies to fossil fuels is a wasteful use of public funds – money is spent twice, while effects of the two policies cancel each other. In Morocco, for example, significant delays in deployment of subsidised solar water heating systems in rural households was caused among others by subsidies to bottled LPG.[11] Another example is Egypt, where massive subsidies to fossil fuels undercuts commercial rationale of investments in renewable energy sources. Phasing out fossil fuel subsidies would allow the taxpayers to save some money used to stimulate renewable energy and spend them for other burning social needs. Phasing-in carbon pricing policies (taxes, market based or even command-and-control) will have a similar effect. It will contribute to renewable energy development while filling in instead of draining public coffers.

- ***Nascent industry and learning effect***
  Pros: Renewable energy technologies (except large hydro) are still relatively novel additions to the power systems. Their market shares are increasing though, and costs are falling down for most renewable technologies. Some of them (large hydro, co-firing biomass, onshore wind) are more mature than others and are already competitive with thermal energy in selected applications. They have, however, smaller potential for further cost reduction. Less mature technologies (like solar PV, offshore wind and some marine technologies) offer greater potential for costs reduction (learning curves are steeper) but their current initial cost remains relatively high. From the micro-perspective subsidies are viewed as rewards to investors for taking extra risk of financing innovative low carbon technologies during early stages of transition towards their commercial maturity. As such, subsidies could "crowd-in" sustainable commercial finance and accelerate learning and diffusion of new technologies until they are competitive with conventional generation when carbon is adequately priced. Subsidies can create a "virtuous circle" as expanding demand for renewable technologies is likely to encourage private investments in technology development. However private R&D increases significantly when industry expects sustainable market growth when subsidies expire. Some analysts argue that "learning effect" is the only economically sensible basis for subsidizing renewable energy above the carbon price.[12]
  Cons: As we will discuss later cost effectiveness causality in the learning curves is not proven. Either deployment causes cost reduction or vice versa (see discussion below and in Annex III). Furthermore even if one believes in the deployment-led cost reduction it is not so obvious who should pay for this deployment – rich or poor countries. At the same time it would be a waste of public funds to subsidize technologies that are already competitive with adequately priced fossil fuels. Also subsidizing "wrong technologies in wrong places" that can never stand on their own feet is a waste.[13]

- ***Job creation and industrial development***. Policy makers and interest groups often hope that subsidies to renewable energy generation will create the demand for the development of the domestic

manufacturing of renewable technologies or their components.[14] This in turn is expected to create jobs and generate export revenues.[15] Indeed, combination of strong R&D potential and access to large subsidised markets has led to some examples of the surges of new competitive renewable industry in Europe and more recently in China and India.[16] In Germany alone it is estimated that the employment in renewable sector has grown to almost 280,000 in 2008.[17]
Cons: Smaller and poorer countries with weak scores on both competitiveness and innovation can not always replicate the comparative advantage of their more technologically advanced peers. The bitter example of the US solar panels manufacturer Solyndra, which had received more than five hundred million dollars in loan guarantees from the Department of Energy before going bankrupt shows how risky can be a directed industrial policy based on wishful thinking. Empirical analyses demonstrate that employment in the economy depends on economic fundamentals (country risk, education and skills, childcare conditions, wage and tax regulations, corruption and overall cost of doing business), rather than on industrial policy support for selected sectors. Subsidies to deployment of renewable projects create international spill-over benefits due to international market for renewable technologies and often support import of more competitive and innovative renewable technologies rather than domestic manufacturing industry.[18] Moreover, job creation should also not be confused with moving jobs around the economy.[19] The cost of creating jobs relative to other sectors and sustainability of these jobs should also be critically analysed to avoid costly mistakes.[20] Some developing countries are introducing local content requirement for installation of renewable power plants. Such requirement may be effective mainly in the countries that have strong market power. Otherwise it can deter efficient investors. It may be difficult for SREP to support projects with local content requirements given the recent complaints of Japan and EU to WTO that the local requirements applied to feed-in tariffs in Ontario, Canada distorts competition and violates WTO rules.

- ***Non-market barriers to investments***.
  Pros: Information asymmetries, high transaction costs, permitting and grid connection gridlocks are just a few of the non-market barriers that affect particularly renewable developers, especially small ones.
  Cons: These barriers can be overcome by technical assistance and capacity building, or more rarely through well targeted investment subsidies (e.g. for connection costs). SREP investment plans could seriously consider technical assistance targeted at removal of specific institutional and regulatory barriers, possibly as a substitute for investment subsidies.

- ***Entrenched behaviour***.
  Pros: This is a corollary of the previous arguments. One of the non-economic barriers to the new renewable technologies is the mental and institutional inertia in the market that increases risk aversion in nascent industries. It perpetuates behaviours that may not be individually rational but are nevertheless deeply engrained such as mistrust in innovative and dispersed clean energy supply solutions. Temporary subsidies can break the vicious circle of risk perception and institutional inertia and overcome lock-out of promising renewable energy technologies. Subsidizing alternatives for fuel wood used by poor rural communities for heating and cooking can also be an effective tool to prevent overexploitation of ecosystems. Such subsidies may need to be as permanent as rural poverty.
  Cons: Renewable energy may not always be the most appropriate technology to achieve the environmental and social sustainability goals. [21] Large scale development of renewable energy may

be a source of environmental stress and conflicts even beyond well documented conflicts over multiple uses of scarce water resources.[22] Subsidies can create another entrenched behaviour of rent seeking and subsidy dependence mentality. Mitigation measures against these risks can partly be embedded in the "smart" subsidy structure, such as performance linked subsidy levels, sun-set clauses and sliding subsidy scales.

- ***Energy security***:
  Pros: Energy importing countries often value renewable energy as it can decrease import dependence on fossil fuels and be part of the hedging strategy against volatility of the fossil fuel import prices. For example, Kenya and Senegal spend more than half of their export earnings for importing energy, while India spends over 45%.[23] Morocco is a particularly energy deficient country, importing close to 95 per cent of its primary energy demand. Such import dependence makes the economy vulnerable to external price shocks.[24]
  Cons: The energy security argument has a flip side. Many renewable technologies are not free from the risk of availability and input price volatility. Hydropower is vulnerable to the fluctuations in the rainfall. Climate change impact will only increase this vulnerability, especially in the countries affected by severe water stress, such as Mediterranean region and Northern Africa. Ethiopia, for example that relies on hydropower for 85% of its power generation has seen some dramatic decline in water availability for power generation. Modelling of future climate change impacts shows even larger challenges ahead.[25] Availability and prices of biomass and biofuels is also sensitive to weather conditions. In Brasil drought and late harvest in 2010 led to lower-than-expected ethanol production, which combined with soaring vehicle sales led to a jump in prices and a surge in imports from US. The biomass used for electricity and heat production in many other countries has seen high price volatility caused by variability of weather conditions of competition from other uses.[26] Energy security is a complex issue that may or may not be addressed by renewable energy support. Diversification of fuel sources, investing in inter-connectors between different power systems, market couplings or demand side management are among the core means of increasing energy security.[27] Renewable support policies may serve this purpose in the countries that are not excessively reliant on renewable energy already. These traditional measures are easier to implement in countries relatively well endowed with natural resources and relatively close to other electricity markets. Renewable energy as a mean of increasing energy security will be more important in isolated island states, such as Maldives.

- ***Equity and affordability***
  Pros: In poor isolated rural communities subsidies to local renewable power sources can provide access to electricity to improve livelihood of poor rural communities.[28] High upfront cost and lack of access to finance may justify capex subsidies. However, once micro renewable energy has been installed, it is important that the equipment earns enough for adequate operation, maintenance and eventual replacement at the end of economic lifetime.[29] Pay-per-use fees are usually fairer and provide better incentives to use renewable energy efficiently, than flat fees and use quota. Targeting subsidies at those in real need is usually the major challenge. With off-grid renewable applications it is easier than with grid connected technologies, where social considerations usually prompt the governments to provide consumer price subsidies for all grid users. Such subsidies primarily benefit rich and middle class, encourage wasteful use of energy and squeeze margins of renewable generators

and network companies, which can not pass their full cost to final consumers. In the countries with more advanced social safety nets the most equitable and sustainable outcomes are achieved by targeting support at income of the poor and vulnerable rather than providing producer or flat consumer subsidies.
Cons: Equity considerations justify well structured support to consumers rather than to producers.

Most arguments listed above justify government intervention, but not necessarily subsidies. Externality is a good argument for subsidies as a temporary substitute for other policy failures (e.g. temporary failure to introduce carbon prices) but not to counterbalance existing subsidies to fossil fuels.

The most solid argument in favour of subsidies is the support for nascent industry and prime movers if renewable energy has potential for learning effect (cost reduction) and replication on commercial basis in future. Changing entrenched behaviour and energy security will justify subsidies for renewable energy in specific rare circumstances.

All other justifications are weak. They promote second-, or third-best solutions when first-best alternatives are available. However, all above rationale can lead to efficient outcomes providing that subsidy interventions are temporary, with a clear pathway to achieve financial sustainability without public support in future.

V. Review of existing subsidy schemes

Subsidies for renewable energy have many different types – direct vs. indirect, operational vs. investment, explicit vs. implicit.

As of 2010 more than 100 countries around the World have been subsidizing renewable energy sources using variety of support measures. The summary of different support measures according to the IEA classification by different group of countries is included in table 2 below.

Table 2: Number of renewable energy support policies in different groups of countries

	Feed-in tariff	Public competitive bidding	Renewable Portfolio Standard, quota	Tradable RE certificates	Capital subsidies, grants, rebates	Public investment, loans, or financing	Investment or other tax credits	Tax reduction	Energy production payments or tax credits
EU27	24	8	5/6*	15	24	18	18	22	4
Other developed countries (14)	7/10*	2/3*	2/4*	4/5*	9	7/8*	4	5	1
Developing countries (40)	17/18*	11	4/5*	1	13	17	17/18*	25	8

*including state-level policies
Source: REN21 2011, IEA policy and measure database, IPCC SRREP report 2011, EBRD documents, and other sources[30]

V.1 Price-based operational subsidies

Guaranteed off-takes of electricity at guaranteed prices (feed-in tariffs) belong to a category of price based operational subsidies and are applied by 52 countries worldwide. Feed-in tariffs are more popular in Europe (89 percent) and other developed countries (61 percent) than in developing countries, where they are applied by 43 percent of all countries supporting renewable energy.

Among various models of feed-in tariffs the most popular one is the **fixed feed-in tariff**, which is a payment per kWh of green electricity fed into the electricity grid irrespective of (and usually above) the wholesale price of electricity enjoyed by conventional generators. The subsidy component paid to renewable generators is usually "socialised", i.e. spread evenly and thinly across all consumers via surcharge on transmission tariffs. Different methods of distributing renewable energy subsidies among final consumers exist.[31]

Some countries applied **feed-in tariff premium** – a fixed adder to the underlying wholesale electricity price that leaves renewable producers exposed to the fluctuations of wholesale electricity prices.

Few countries, like the Netherlands and Denmark (for off-shore wind only) have used **fixed feed-in tariff with contracts for differences**. Under FIT with Contract for Difference (CfD) the low-carbon generator receives revenue from the wholesale market for its output and either receives or makes a payment-based on the difference between the average wholesale market price and the tariff agreed in its contract. The British government has recently proposed such a feed-in tariff structure for the UK although a reversal to the traditional style FIT is also considered.[32]

Many lower income countries want to cap consumers' burden of operational subsidies by purchasing limited volumes of renewable electricity through **long term power purchase agreements (PPAs)**. Producers obtaining such PPAs can be selected either directly by the national governments or through competitive tenders open to all qualified IPPs. Examples of countries organizing different forms of auctions for renewable PPAs include Brazil, Peru, Morocco to name just a few.[33] In most of these countries the preference for tendering PPAs by the state agencies is a legacy of the centrally planned structures of the power systems, with single buyer model and a lack of market platform.

The World Bank has recently structured its loan for Ouarzazate CHP plant in Morocco as a quasi-feed-in tariff (box 2).

Box 2. World Bank loan finances quasi-FIT in Morocco

In the Ouarzazate I the concessional loan of the World Bank is structured as a "feed-in tariff component", where the World Bank loan will finance Government of Morocco's coverage of the difference in price at which MASEN (state agency) buys from Solar Power Company (SPC) and sells to ONE (state power utility), the kilowatt-hours produced by the project. The selling price by SPC to MASEN reflects the Levelized Cost of Energy (LCOE) for CSP, once the capex grants are factored in to reduce the investment cost. The selling price by MASEN to ONE reflects the wholesale price of electricity in Morocco which is essentially driven by the levelized cost of coal generation.[34]

V.2. Quantity-based operational subsidies

Quantity based operational support usually takes a form of Renewable Portfolio Standards and Quota Systems. As of 2010 as many as 15 countries, mainly advanced industrialized economies, have used various forms of **renewable portfolio standards (RPS)**. Such systems oblige suppliers to utilize specified quantities (quotas) of renewable energy resources in their portfolios. Suppliers must source the certificates of origin of electricity from renewable producers at an agreed price, which is usually lower than the penalty that supplier must pay to the regulator for surrendering less certificates than the quota.[35] As of 2010 quota system existed in more than 30 states in the US as well as countries such as Australia, Belgium, Canada, Chile, China, India, Italy, Japan, Poland, Romania, Sweden, Taiwan and United Kingdom.

V.3. Quantity and market-based operational subsidies

As RPS schemes are widespread in US, several European countries developed quota systems that allow trading of certificates of origin called **tradable green certificate schemes (TGCs) or Green Certificates**. With TGC systems, a target for Renewable Energy penetration is set by public authorities and every supplier obtains an obligatory share of this target. Suppliers seeking to minimize the cost for achieving their targets purchase certificates from the least-cost generators. The certificate price is set by the market usually subject to a cap in the form of a penalty price. Among developing countries only India introduced a market for the certificates of origin from 2010. Most recently UK announced a migration away from its tradable Renewable Obligation Certificates (ROCs) towards feed-in tariffs (possibly with CfD).[36]

V.4. Direct investment subsidies

Investment support in the form of **capital grants**, rebates, or grant buy downs are very widespread in relatively rich countries. In EU 24 out 27 countries (89 percent) apply them for renewable projects. Poorer developing countries are less generous and only 13 out of 40 countries (33 percent) offer grants to renewable project developers. There is a stark difference between the widespread use of capital grants in EU and much less common investment support in developing countries, which usually prefer to dip into the public coffers indirectly and less transparently through various forms of tax credits and tax reductions.

V.4. Concessional loans and equity

Concessional loans are commonly used to finance renewable energy projects by IFIs. EBRD's mandate of supporting transition to market economy prevents below-market pricing of its financial products. Concessionality of IFI loans can also be "hidden" in maturities longer than available on the market.

Government sponsored equity is for renewable is rarely used in developed countries. In Morocco state agencies provide 30% equity stake in wind development SPVs with IPPs. The intention is to reduce political risk to business by having government stakeholders in the companies. But on the other hand it increases the risk of political interferences and distortions to commercial operation of the projects

V.5. Indirect and implicit subsidies

Operational support in the form of **tax subsidies**, such as waivers, refunds or reductions of sales taxes, VAT, energy taxes and excise duties on the sales of renewable electricity are the most common form of support for renewable energy in developing countries, although its effectiveness in attracting investments remain questionable. Another commonly used tax instruments are **investment tax credits**, such as accelerated depreciation or tax waivers of capital expenditures. In US securitized tax credits are used to raise investment finance for renewable energy projects.

A number of developing countries offer state guarantees to investors' lenders as a mean to attract investors to the energy sectors plagued by high regulatory risks caused typically by the privileged position of state owned generators vertically integrated with the state owned buyers of electricity.

Few countries use public funds as a **risk-sharing** cushion for financial intermediaries to encourage them to engage in lending for renewable energy. Using SREP subsidies to share the risk with commercial financial intermediaries on the portfolio of their renewable projects (e.g. on a first-loss basis) can leverage significant affordable funding for smaller, decentralized renewable technologies

V.6. Blending SREP subsidies with national subsidies for the same project

Blending of SREP subsidies with other subsidies provided through IFIs, international organizations or donors is ruled out by the SREP financing modalities document. However, the issue of blending with subsidies financed by domestic consumers and budgets is an open question.

Blending of many subsidies in the same project can have an economic rationale if each is targeted at distinct market failure (e.g. R&D subsidy addresses the knowledge spillover effect while investment subsidy may be targeted at environmental externality).[37]

If the operational revenues event with subsidies (e.g. feed-in tariffs or green certificates) are deemed not sufficient to make certain projects commercially attractive at a given cost of capital, a "funding gap" method is used for example in the EU to determine the grant element. The funding gap for the revenue generating projects equals the value of the investment cost less the present value of the net income from this investment over a specified reference period discounted with a prevailing hurdle rate.[38] Funding gap is particularly applicable in support of the project finance structures.

Sometimes even different national subsidy mechanisms overlap. Many countries tend to avoid blending different subsidies for the same project types. For example in Germany the access to capital grants is limited to the renewable projects that are not eligible for feed-in tariffs (mainly thermal and off-grid energy). Project developers are expected to raise initial funds on the market against the low risk revenue from the feed-in tariff during the long term power purchase agreement (PPA). This can be expected if the project developers are experienced in RE business, if the countries have relatively well functioning capital and financial markets and other policies are in place to keep investment risk low (predictable licensing and permitting procedures, enforceable contracts, etc.). Some other advanced countries (e.g. Poland, Romania) do provide different forms of subsidy to the same renewable projects (e.g. green certificates and capital grants).

Several developing countries apply multiple overlapping subsidies in desperate efforts to attract independent investors (IPPs) in a distorted market environment. Often the cost of these subsidies is not passed through to energy consumers, but instead absorbed by the government owned entities and eventually passed to the budget (all taxpayers). Such subsidy incidence mitigates the short term risk of social unrest often sparked by increases of energy prices. However, it misses the opportunity to receive feed-back from consumers, when subsidy burden becomes unsustainable. It is less transparent and less efficient allocation of subsidy cost also because facing low prices consumers are also less interested in rational use of energy. It is also not fair and disproportionally affect the poor, as social spendings must be cut to subsidize energy cost to all, including the rich, who use it most.

Such system often leads to a hidden accumulation of fiscally unsustainable debt and implicit and contingent liabilities in the public sector. When a fiscal bubble eventually explodes it may undercut public and political support for renewable energy. Such sentiments are recently observed in several EU countries.

The number and level of subsidies to new renewable projects developed by IPPs can usually be significantly reduced if the governments improve fundamentals for investment climate and establish energy market rules that reduce risks to renewable investors. This is further elaborated in section V.8.

Table 3: overview of the electricity market structure and institutions in the SREP pilot countries

Ethiopia	Honduras	Kenya	Maldives	Mali	Nepal
Market structure					
State utility Ethiopian Electric Power Corporation (EEPCo) acts as the sole power producer and distributor on the grid. Competition is negligible. Draft bill (Energy and Feed-in Tariff Proclamation) to allow IPPs to supply power to national grid in October 2011.	Unbundling and privatization of Empressa Nacional de Energia Electrica (ENEE) in 1994 failed. Power sector was restructured in 1994 and principally opened to private investors; ENEE still dominates the sector.	Unbundling 1997: **Generation:** KENGEN (70% state owned) is in direct competition with IPPs (20% of the market) that have power purchase contracts with Kenya Power and Light Company (KPLC), which is the single buyer. **Distribution/transmission**: KPLC (51% state owned). 150.000 Solar Home Systems (SHS) sold by private sector for 50$ each.	Vertically integrated, state owned power utility STELCO is responsible for generation, distribution and retail of power on 24 of 200 inhabited islands. Competition is negligible. Other islands receive electricity from Island Development Committees (IDSCs) and private companies.	Vertically integrated Societe Energie du Mali (EDM - 66% shares state, 34% shares private IPS West Africa). Decentralised service companies for off-grid power SSD Koutiala, and SSD Kayes. Rural concessions and management contracts in place.	Nepal Electricity Authority (NEA); Vertically Integrated; Functional unbundling introduced. Networks fully state-owned. Various IPPs that provide power to NEA.
Market institutions					
Ministry of Water and Energy Electricity Agency (Supervise generation; Study and recommend a tariff) Rural Electrification Fund (REF)	- Ministry for Nature Resources and Environment (SRENA) - National Energy Commission (CNE)	- Energy Regulatory Commission (ERC)	- Ministry of Energy, Environment and Water (MEEW) - Maldives Energy Authority (MEA)	- Ministry of Mines, Energy and Water - Regulator CREE - Rural electrification initiatives AMADER and HEURA	- Ministry of Energy Department of Electricity Development - No utility but Electricity Tariff Fixation Commission - Alternative Energy Promotion Center (APEC)

Energy tariffs					
LOW: 0.06 US$/kWh HH pay 50-100 US$ to connect to EEPCO's grid	LOW: US$/KWh	MEDIUM: Residential: 0.2 US$/kWh; Additional monthly fixed charge Industry: 0.15 US$/kWh	LOW: 0.07 – 0.11 US$/kWh	MEDIUM: 0.11 (<50 kWh) to 0.22 US$/kWh	LOW: Residential: 0.05 US$/kWh Industry: 0.09 US$/kWh
Subsidized	Subsidized, the total cost is estimated at 0.1275 US$/kWh 5).	Special tariff for low consumption range.	Subsidized	Subsidized	Subsidized, current tariff is not covering cost.
RE support measures					
Biofuels obligation Planned FIT 3) Tax relief for private investment	FIT Premium Tax exemption	FIT for various technologies	None	Reductions in sales and VAT tax	Investment subsidies Custom and VAT exemption for equipment Hydro projects <1000 kW: No license, no income tax

VI. Evaluation of the different support mechanisms

V.1. Criteria for evaluation of subsidy schemes

The assessment of various forms of support for renewable energy and their potential interaction with SREP financing will refer to the following criteria:

- Effectiveness;
- Cost-effectiveness;
- Leverage of investments;
- Sustainability of subsidized activities;
- Administrative costs;
- Transaction costs;
- Market integration;
- Incidence;
- Affordability;

V.2. Effectiveness

Effectiveness is the single most commonly used yardstick of success of renewable policies. It is a measure for the impact of a policy on the rate of deployment of renewable energy (either in terms of capacity installed or energy generated). It is widely documented that guaranteed off-take and prices (feed-in tariffs) are the most effective instrument to deploy renewable energy mainly due to low risk to investors.

FIT are not necessarily effective in the countries where regulatory risk is high, for example because of perceived probability of reversal of support policy. The risk to investors also increase when system operator or the government agency in charge of buying electricity and paying FIT is not creditworthy, for example because of large accumulated debt and limited ability of pass all the renewable purchase costs to customers.

Their effectiveness is also determined however by how they are applied. Inconsistent application and poorly enforced feed-in contracts weaken their effectiveness. Care needs to be taken to make comparisons between systems with a similar degree of development. For example, the German FIT is usually compared against the British ROC, but the former is a well-established system, whereas the latter is relatively new and inconsistently applied. Many observers note that the key reason for the low effectiveness of the British support system was unpredictability and the high transaction costs of planning and permitting procedure, rather than nature of the support system[39]. For example the Polish green certificate system has stimulated an almost 6-fold growth of the wind capacity between 2006 and 2010 to almost 1 GW, albeit from almost negligible initial level.[40]

V.3. Cost-effectiveness

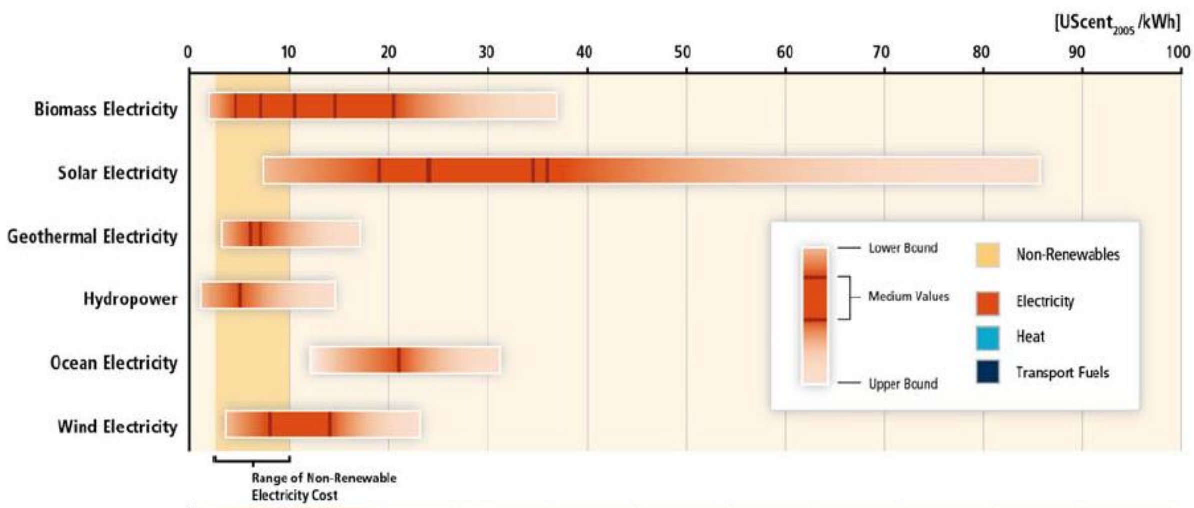
Willingness to pay a premium for renewable energy is larger in wealthy countries, where consumers are both able and willing to pay a high price for "green" energy. Western European governments seem to have a mandate from societies to support also the objective of developing comparative advantage in manufacturing of innovative renewable technologies. The fundamental question is whether the same ability and willingness to pay can be expected from developing countries where the primary goal is to improve access of poor people to electricity or to keep electricity prices at affordable levels. Having lower incomes, the developing countries can afford proportionally lower levels of overall support for renewable energy. Likewise, the public acceptance of high electricity prices is weaker and arguments that renewable energy is "a good thing to do" are not supported by the same willingness to pay. Public support to renewable energy can be undermined if subsidies impose high burden on consumer prices or create permanent windfall profits to investors.

Developing countries would be able to install more renewable capacity if their limited budget was used to support lower-cost renewable technologies rather than the expensive ones. Maximising renewable capacity per each Dollar spent is particularly important in developing countries because their incomes are lower.

SREP will not be able to ensure a continuous containment of impact of RES support on electricity prices. Once SREP funds are spent, however, the country should not be left with an excessively costly legacy of a renewable portfolio which will need to be shouldered by its own citizens. SREP should not provide temporary relief which would mask the build-up of long-term financial liabilities.

Long-run generation costs (sometimes called levelized cost of electricity) vary dramatically among renewable technologies and locations from as little as about 2 USD/MWh for mini-hydro or wind in good location to over 80 USD/MWh for certain solar technologies (figure 1). On average for most technologies and sites it is still significantly higher than the cost of thermal electricity fed to the electricity grid.

Figure 1: Life-time levelized cost of energy: renewable versus conventional



Source: *IPCC, SRREN 2011*

The less mature, expensive technologies may not be economically viable even when environmental externalities are accounted for (see box 3). According to the World Bank the estimated levelized cost of electricity generation for concentrated solar power in developing countries are 22 – 37.3 US cent/kWh in Morocco, 26.7 – 35.5 US cent/kWh in India and 23.8 – 42.3 US cent/kWh in South Africa, depending on the CSP technology[41].

Box 3: Financial and economic impact of the first Concentrated Solar Plant in Ouarzazate, Morocco

Financial analysis of the pilot 125 MW CSP plant with 3 hours storage in Morocco (Ouarzazate) conducted for CTF indicates that even with concessional financing, bilateral grants, and multilateral and bilateral financing, the project's *financial viability* is contingent upon a very high sale price of the electricity generated. This heavily subsidised price is still more than double the average wholesale price in Morocco and requires substantial government subsidies, external financing and/or exports to higher value markets, the latter of which is under discussion but is unlikely for this first project.

The estimated unsubsidised price (levelized cost of electricity for parabolic trough technology for Morocco) of 37.25 US cents/kWh[42] is roughly four times higher than the current wholesale price. Electricity will be bought from the IPP at a negotiated (probably subsidised) price by the special government owned agency MASEN with state guarantees and will be sold at low wholesale price to the state integrated utility ONE. The difference between the buy and sell price will be covered by the budget transfers to MASEN. ONE sells electricity to distribution companies and end users. Current retail price is on average lower than wholesale price. The operational losses of ONE have already reached 100 mln USD in 2010 even before Ouarzazate CSP is connected. They are covered by the budget, and further increase may put a strain on public finances especially as the government is planning measures to cut fiscal deficit from 5% of GDP in 2010 to 3% of GDP. The renewable support in Morocco aims at creating low risk environment to investors, but in the absence of the wholesale market and competition in generation they put a strain on consumers and public budgets and may not be sustainable under tight fiscal environment and regulated retail electricity prices.

According to CTF document The project is also *not economically viable*, even when factoring in local and global environmental benefits. Based on estimated project costs and prevailing fuel prices by end of 2010, the project is not part of the least-cost generation mix.[43]

Notwithstanding lack of both financial and economic viability the IFIs and the government of Morocco decided to support the project for two reasons: (i) promise for electricity exports at higher than domestic prices, and (ii) promise for a boost to local manufacturing and create jobs.[44] The export prices are unlikely to cover even subsidised costs, to say nothing of the levelized cost of electricity. The manufacturing promise is yet to pass market test.

Ouarzazate is very large as a CSP project, but will not dominate the Morocco's generation capacity. However it may set the precedent for the support system, that may not be sustainable when scaled up to meet the government plan of 2GW of installed solar electric capacity by 2020.

Support policies are often driven by the "fairness" consideration that the rates of return for different technologies should be more or less equal. This leads to higher subsidies for expensive and less mature technologies to encourage their accelerated deployment, which would not be possible under a more competitive environment. In a number of countries the commitment to support such technologies has already led to the build-up of significant financial liabilities in the electricity systems. The good example is the solar PV "boom and bust" in selected EU countries (see box 4).

Box 4: Rush and crush of solar PV in Europe

Spain and Germany pioneered in introducing high feed-in tariffs for solar PV in the middle of the decade. For a few years an increased demand triggered by these tariffs and insufficient competition on the supply side kept the prices of solar panels high. This was contrary to the learning effect theory (see figure 4). In 2008 the competition of Asian manufacturers finally brought the prices down. This caused a golden rush for new investments. In Spain the new solar capacity added to the grid in 2008 increased five-fold on year-to-year basis. Solar investment boom continued in Germany until 2010.

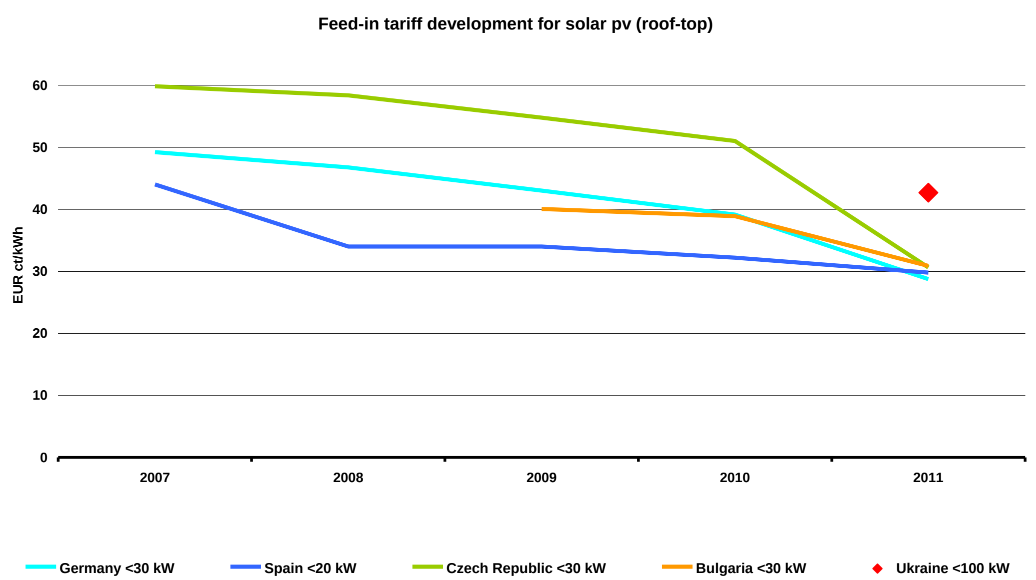
Table 4. New installed solar PV capacity (MWel per year)

	2007	2008	2009	2010
Germany	1270	1950	3795	7405
Spain	560	2600	145	370
Czech Republic	3	60	400	1490

Source: REN21. 2011. Renewables 2011 Global Status Report

This caught governments and regulators by surprise. Spain, Germany, Czech Republic and Bulgaria embarked with somehow hectic cuts in the level of support to solar PVs in order to shield current and future electricity bills.[45] These trends are illustrated on figure 2. Ukraine stands out as the next candidate for boom-and-bust scenario. The country introduced FIT late (in 2011) matching the historical high rates of the Western peers.

Figure 2: Adjustments of solar PV feed-in tariffs in selected developed countries



In Spain the solar bonanza has contributed to a fiscal crisis. As the regulated retail electricity rates remain low utilities accumulated significant system deficit, which in the past was traditionally financed by the utilities themselves through selling packaged securities on the capital markets. When the global financial crisis hit, utilities were no longer able to find buyers for their securitized debt. Instead of allowing steep increase in electricity rates the government stepped in by guaranteing the utility securities effectively assuming liability for over 20B EUR in debt.[46] To prevent the build-up of further liabilities the government tightened annual capacity caps in 2009 and undertook and effort to retroactive change prices on already signed FIT contracts. Solar PV generation costs exceeded what utilities could charge by the largest amount, making it the largest proportional contributor to the deficit: while it supplied roughly 2 percent of total electricity to the grid in 2009, it was responsible for approximately 12 percent of total electricity system costs in that year. [47]

The relatively less experienced legislators and regulators in developing countries may find themselves under pressure of industrial groups to introduce tariff support systems that match past generosity of Spain, Germany or Czech Republic with potentially dire long term consequences for end use prices and fiscal space. Certain most expensive renewable technologies can impose high burden on customer bills or public budgets if developed on a large scale.

The debates on how the design of support systems influences the total cost of support are widespread but usually misleading. They confuse economic concepts of costs and consumer surplus (box 5). Most analyzes concluded that technology specific support systems can effectively discriminate between prices paid to different technologies and reduce the cost of support. However these studies looked at the cross country comparison of single technologies rather than comparison of the portfolios of all renewable technologies (box 6). They were also conducted before the solar PV boom-and-bust in Europe.

Box 5: Efficiency, cost-effectiveness and consumer surplus

The literature on the costs of renewable support under different regimes excessively focuses on producer surplus within the 'silos' of individual technologies. [48] They tend to compare cost of support for single technologies (e.g. wind-to-wind) across countries. Very few studies compare total renewable support budgets across the portfolio of all technologies.[49]

Efficiency of a policy or a project is in economic terms the difference between the present value of its benefits and the present value of its costs. When benefits are difficult to estimate or are considered the same for different policies, the economic assessment can be reduced to ***cost-effectiveness*** (cost per physical unit of benefits). For the purpose of this note cost-effectiveness is defined as the ratio of the total incremental consumers/tax-payers' cost of support to the volume of renewable electricity fed into the grid. Cost-effective policies are those that enable achieving renewable generation target at the least overall cost to consumers/tax-payers.

One of the renewable policy objectives is to minimize the costs of the entire renewable generation to a community or a country. It does not necessarily imply minimizing a grant component at the project level or minimizing ***producer surplus*** for a specific technology.

This approach to efficiency and cost-effectiveness differs from some approaches used in the literature. For example, an OPTRES study[50], which underpinned the European Commission's proposal for a directive on the promotion of the use of energy from renewable sources,[51] defined efficiency as a difference between the level of support and the generation cost. The closer the two are to each other, the more the policy is "efficient", authors argue. This study confuses the economic concept of cost-effectiveness in two dimensions. First, the OPTRES study compares producer surpluses only instead of the total cost of support to consumer (or taxpayer), which is the sum of producers' surplus and producers' cost. Second, OPTRES study compares surpluses with the “silos” of single technologies.

Technology-specific or technology-neutral support systems

For individual technologies indeed the price discrimination (through technology specific FITs or technology specific multipliers for TGCs) can transfer some of the producer surplus to consumers. Differentiated tariffs can be more tailored to the generation costs of different technologies and thus reduce surplus to low cost renewable generators. However, the flip side is that price discrimination attracts more investments in the expensive technologies that would not be competitive under technology neutral support systems. This can increase the total support cost for the entire portfolio of renewable technologies. The net effect will depend on the relative weight of producers' surplus and producers' costs in the total cost of support. This is explored more technically in boxes 5 and 6 and further in Annex III.

Box 6: Technology-specific or technology-neutral support systems – which is cheaper?

Amid confusion between the total cost of renewable support and producer surplus for specific technologies, a number of analysts conclude that technology specific support schemes are more “efficient” because price discrimination shaves producer surpluses for the cheaper renewable technologies.

Cost comparison of support schemes looks differently when total cost of the portfolio of diverse renewable technologies is taken into account instead of individual renewable technologies being assessed one by one. Technology specific tariffs, while reducing surplus to low cost renewable generators, encourage larger production from more expensive sources.

If the correct measure of efficiency is taken as the objective function the policy conclusion may very different. Technology neutral support policies, be it through market based measures (TGCs) or technology neutral feed-in tariffs, would be the least-cost policy instruments. The choice of the type of support (price based versus quantity and market-based) is less important for this purpose. Even green certificates can be designed with technology specific multipliers that will increase overall cost of support. This is demonstrated in box 7 below.

Technology neutral support policies will not always minimise the total cost of support. If there are constraints in the choice of renewable technologies to meet a given target, a very expensive technology may set the equilibrium price and the producer surplus of all other generators can inflate the total cost of support. Tariff discrimination can reduce total cost to consumers only if:

- economic potential of any given technology or region is fixed and fully exploited;
- and substitution between different RE technologies in delivering RE targets is limited.

If these two constraints are not immediately binding it can be reasonably expected that technology neutral support will deliver a cost-effective portfolio of renewable technologies.

Box 7 below includes an empirical test of the above hypothesis. Operational support under green certificates in Poland and Romania seem to have been lower, mainly because the technology neutral green certificates did not favour expensive solar PV plants and increased share of cost-effective technologies in the total renewable mix. Introduction of technology specific multipliers to the green certificate price in Romania dramatically changes the picture. Adding grants and concessional loans on the top of operational subsidies also alters the total cost of support.

Box 7. Comparing different support measures for renewable energy

EBRD conducted an assessment of the total cost of renewable subsidies for total mixes of several renewable technologies in selected countries using different renewable support schemes – fixed FITs in Germany and Bulgaria, technology neutral TGCs in Poland and TGCs with multipliers in Romania.

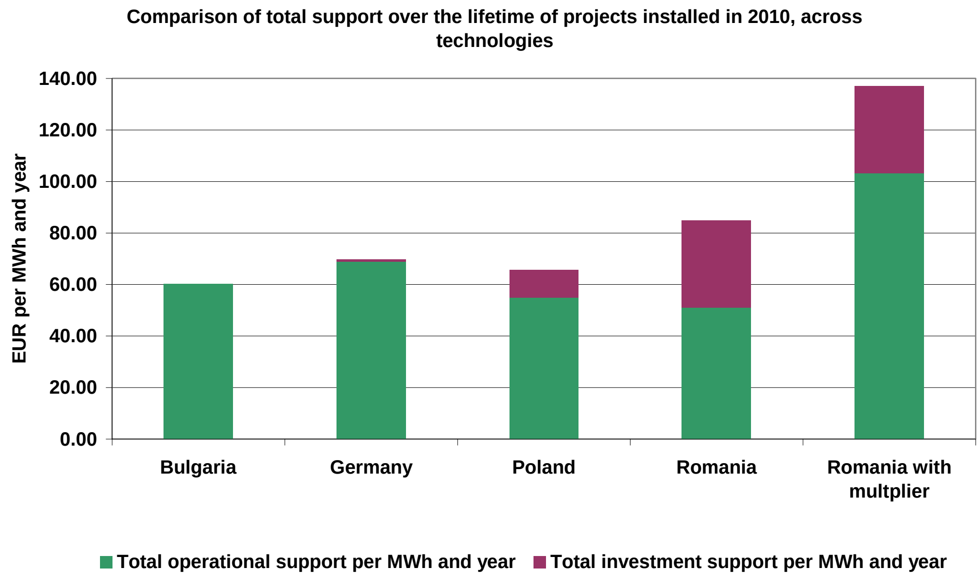
The assessment encapsulates the value of total investment and operational subsidies provided per MWh of renewable electricity produced in these countries over the lifetime of renewable energy projects installed in 2010. The results are weighted average support values over all technologies, i.e. biomass, small hydro, solar and wind. Where a country applies overlapping subsidies these were also included and converted to comparable units. For example concessional loans and grants have been recalculated into FIT-equivalents.[52] The up-front payments were annualized over a period of 15 to 20 years and expressed as feed-in-tariff premiums per MWh produced per year.

The lighter green bars on the bottom show the total operational support which is lowest in the countries with technology neutral green certificates schemes, Poland and Romania before the latter introduced technology specific multipliers. The Romanian scheme has been changed in 2011 by introducing a multiplier for certain technologies. Solar electricity now receives six instead of one certificate per MWh. The last two bars on the right show that the total cost of support in Romania will increase significantly after multipliers are introduced.

In Germany, tariff payments for the seven gigawatts of solar capacity installed in 2010 are responsible for the high cost of subsidy. In Poland the total cost of renewable subsidies are driven down by the 50% share of co-firing of biomass in large combustion plants which is cost-effective choice of many developers in Poland. Co-firing is not eligible for support in other countries.

The darker purple bars illustrate additional subsidies provided through investment grants and concessional loans. In Romania this additional investment support available to renewable generation is particularly generous.

Figure 3: Total operational and investment support for all renewable technologies in selected countries expressed as a feed-in tariff equivalent



Source: EBRD[53]

Market friendly support policies, such as green certificates, are often considered more costly to consumers. Indeed investors take two additional risks – the risk of wholesale electricity price and of renewable price premium. Investors price this risk into expected return and thus expect higher revenues per MWh than under long term power purchase agreement under a fixed price (FIT). However, this argument ignores the costs of reduced flexibility of the support system – when renewable generation costs drop green certificate supply and price adjusts automatically, while with FIT the fixed price has to be paid throughout a duration of a contract (usually 15 – 20 years) and eventual degression rate has to be fixed upfront.

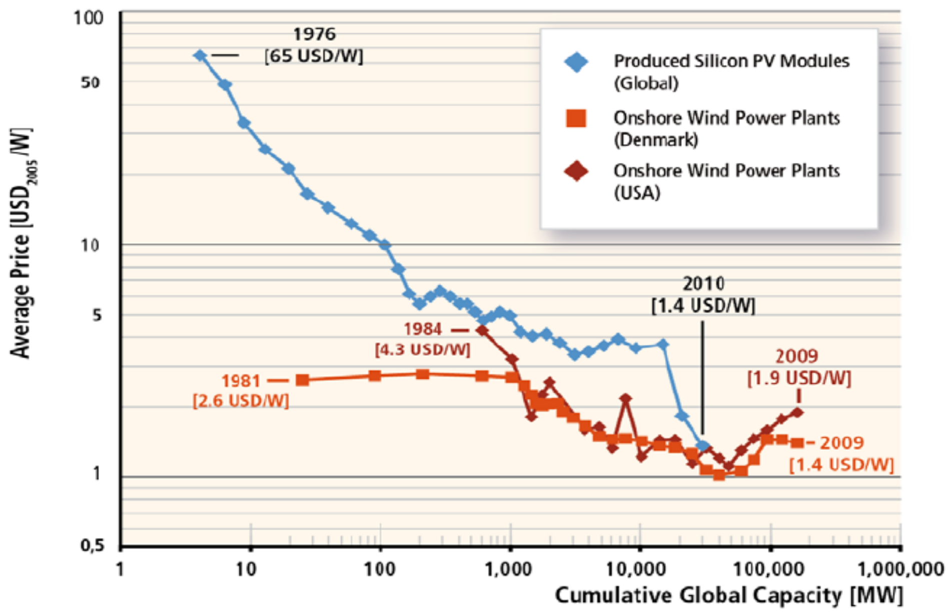
Least-cost renewable technologies for niche, off-grid or mini-grid systems or for decentralized thermal applications are relatively easy to determine through feasibility or least-cost studies. The cost-effectiveness analysis of renewable energy mini-grid options versus grid extensions should underpin the development of rural electrification planning and SREP investment plans. [54] Such frameworks need to clearly define grid extension plans to give predictable framework for investors and predictable costs to customers.

Learning effect – dynamic cost reduction

Many authors argue that in the long term subsidizing various technologies in proportion to their current cost stimulates **learning effect**, which is expected to make the technologies that are expensive today cost-competitive in future (shift the supply curves downwards). The learning effect hypothesis is weakly supported by evidence. Cost reduction is not necessarily primarily driven by the scale of deployment although there are some strong arguments in favour of a virtuous circle between the size of subsidy induced demand and private R&D expenditures that cause technology progress and cost reductions.[55].

The deployment support policies (e.g. excessive subsidies) in unfortunate market conditions can actually drive the prices upwards as could be seen for solar PV and wind plants in the years 2004-2008 (see figure 4).

Figure 4: Learning curves for solar PV and wind



Source: IPCC SRREP, similar data for solar PV can be found in Beyer and Gerlach[56]

Even if the learning effect was true it would not imply that all countries should pay for deployment of very costly, immature technologies. In some cases, the optimum strategies for a low income countries may be to wait a few years until the generous R&D and deployment subsidies in wealthy countries decreases costs and improves reliability of a new renewable technology. In the meantime the scarce resources available at home can be used to foster deployment of cheaper and more mature technologies.

Learning effect debate is further elaborated in Annex IV. As argued there the learning effect is not a compelling argument in favour of subsidising the deployment of expensive renewable technologies by all countries. Expected market size matter but technological progress and increased competition among suppliers of equipment are the result of a broad range of interlinked policy incentives and market conditions.

Hidden and unaccounted costs

As discussed earlier on the energy security arguments, the renewable energy can reduce exposure of the energy import dependent countries to the price volatility of fossil fuels. Morocco for example is a particularly energy deficient country, importing close to 95 per cent of its primary energy demand. Such import dependence makes the economy vulnerable to external price shocks.[57] In 2008 the public deficit in Morocco soared from less than 2% to 5% in one year – an increase attributed mainly to the jump in international oil prices, which was not passed through to final consumers because of domestic fuel price subsidies. This was one of the reasons why the government decided to adopt ambitious renewable energy support measures. However, unaccounted costs and risks of renewable technologies, such as availability and price volatility of renewable resource inputs also need to be carefully assessed in particular when the share of renewables can pose a systemic risk to a power system. Table 5 below summarises the typically unaccounted costs of both conventional and renewable generation.

Table 5: Unaccounted costs of different energy sources

Fossil fuels/nuclear	Renewable energy
– Environmental/heath damages/risks – Fuel price volatility – Limited diversity of fuel mix – Scale and finance requirements	– Intermittency (system balancing costs) – Availability (e.g. water during droughts, biomass) – Input price volatility (biomass, biofuels)

V.4. Grid integration

Except the cost, another barrier to renewable penetration in some countries may be related to transmission planning. Planners are used to control where and when generation projects will be built and to plan the growth of the transmission grid accordingly. Changing the rules of the game to a reactive transmission planning approach is unfamiliar to them, especially in the context of grids that are much less dense than in developed countries. One possible way to use SREP resources would be to subsidise carefully planned, cost-effective reactive transmission investments.

Subsidies can also cause too rapid deployment of intermittent renewable sources which can unsettle grid stability and reduce flexibility of the power system. Usually the system operators find the grid management more challenging only when the share of capacity from intermittent "must run" renewable sources in the grid increases above 10 percent.[58] These risks must be mitigated by investments in grid strengthening, "smart" grid management flexible back-up capacity (e.g. large hydro, gas), energy storage and interconnections.[59]

The challenge increases further if the share of small distributed sources dominate the renewable generation mix. Moving from a centralized system to the one where one third of electricity comes from distributed sources require a number of adjustments to business as usual, including: reverse power flow on networks, load balancing, storage requirements, phase unbalance, harmonics, and ancillary services. [60]

The issue of how transmission and distribution is being priced becomes particularly important for scaling up renewables in developing countries. Often governments, in conjunction with multilateral development banks, push for expansion of centralised grids throughout a country. Such projects tend to be heavily subsidized (e.g. through low costs of capital). Cost recovery and cost allocation models within the countries often create tensions by integrating large cross subsidies from centralized, high population districts to more remote, lower population districts or from industry to population and agriculture.

Governments usually finance grid extensions, but fail to provide an equivalent support to RE-based decentralized solutions. SREP investment plans may include different considerations for grid connected and off-grid renewable systems. Off-grid & mini-grid renewable technologies in developing countries often competitive with diesel generators or grid extension investments. Ideally, proper investment analysis would show the break-even point between extension of centralised grid and development of decentralized mini-grids or off-grid generation.

V.5. Market integration

In many low income countries electricity markets are at their infancy. Power sectors are dominated by state owned vertically integrated monopolies usually with poor performance records in terms of access to electricity and quality of service. Energy sector regulators – if exist – are embedded in the ministerial administrations and lack necessary powers to ensure long term security of supply and fair predictable rules of the game. Table 3 summarises market structures for the SREP pilot countries.

A number of low-developing countries have embarked on the unbundling and market opening process. In generation, the main objective of opening is to attract direly needed investments by independent power producers (IPPs). Usually the first modest step is to open generation to competitive entry of IPPs under the auctioned concessions or power purchase agreements with the single buyer, who normally is the state owned incumbent. Such buyer typically owns the rest of the electricity system and retains control over the remaining generation. Among the SREP pilot countries Kenya, Honduras and Nepal have been able to attract some IPPs, but still covering minority of generation that is dominated by state owned incumbents (partly unbundled in Kenya and Nepal). Few analyses looks at the links between the renewable support policies and the underlying market structures.[61]

While correcting distortions related to environmental externalities, the renewable support systems introduce several other distortions to competition and efficiency of the energy markets, especially for the grid-connected renewable sources. Long-term power purchase agreements, priority dispatch, waivers from balancing charges, broken links between payments for, and the value of electricity (e.g. depending on demand profile) – all these elements weaken and confuse market price signals, constraint competition and reduce flexibility of system operators to build a value-based merit order. The public debates on RE-S support tend to focus on the immediate impacts on the renewable generation itself. We argue that the SREP investment plans should also look at the impacts its interventions may have on the overall energy market structure and its performance in the medium and long term. [62]

Low income countries who are struggling to attract investors to their first large scale renewable power plants can learn lessons from countries where intermittent power has already a significant share of total power production. This applies particularly to countries such as Denmark, Spain and Germany, where the share of wind in terms of total power supply is 21%, 12% and 7% respectively. In these cases, wind power is becoming an important player at the power market and can significantly influence prices and stability of the system, although these challenges are manageable.[63] Modern, flexible electricity system management models that are renewable-friendly also improve overall system reliability and quality of service to consumers. General improvement of market structures and market deepening, such as introduction of intra-day trading or market for ancillary services also facilitates integration of intermittent renewable technologies, while at the same time improving efficiency of the entire power system.

The cost of balancing and intermittency increases total system costs. Guaranteed off-take and prices are non-market instruments that do not support the development of liberalised and competitive electricity markets. They weaken wholesale price signals and constraint cost-effective dispatch flexibility.

Renewable support instruments can be designed to encourage market integration. They can be listed in the descending order of market-friendliness: tradable green certificates, FIT premiums with contract for differences, premium FITs, demand oriented tariff differentiation, special incentives for market participation, or "integration bonus", like e.g. in Germany). Non-distortionary, technology-neutral support systems are usually more market-friendly than centrally planned rates.

Market integration design features are usually criticized by investors and project developers who often prefer security of long term power purchase agreement. This is less of an issue in the centrally planned and state controlled energy systems. However, governments, who are trying to develop efficient and competitive electricity markets are struggling to find the right balance between the goal of supporting the renewable industry and the ultimate objective of having an liberalised and competitive electricity markets which encourages efficient behavior of investors and gives consumers high value at low cost.

V.6.Incidence and affordability

National support systems are disbursed to beneficiaries by the authorized agencies. Grants or tax credits are managed by the ministries or specialized funds. System operators or government agencies pay feed-in tariffs or buy green certificates. The costs of the latter are then ideally passed through via transmission and distribution tariffs to all consumers or to taxpayers if pass-through is not possible.

Costs of grants, interest subsidies or tax credits are ultimately charged to the whole population of taxpayers. If investments are financed by long-term debt (e.g. from MDBs) the cost is effectively transferred to future generations. Monitoring of both ability and willingness to pay by consumers or taxpayers needs to be maintained in order to take corrective actions on time to avoid public backlash against renewable energy targets. SREP investment plans should include thorough assessment whether SREP and associated MDB loans do not unduly reduce fiscal space or consumers' ability to pay for scaling up of renewables in order to avoid crowding out of future investments.

Public agencies may not be able to pay e.g. feed-in tariffs if they are not allowed to pass their burden to the consumers. Some FiTs failed to attract investments because of this credit risk of government entities. SREP should always link its financing with improvements of transparency and methodologies of allocating renewable costs to final consumers.[64]

Absence of electricity markets and independent sector regulators can also trigger fiscal contagion of RES support systems. Heavy involvement of governments in the electricity sector in developing countries (single state owned buyers) and lack of financial transparency in unbundled systems can mask the build-up of indirect and contingent fiscal liabilities that may be difficult to handle once finally unearthed by the lenders and bond holders or angry people on the streets.

Individual SREP supported projects are unlikely to create systemic risks. However, the catalytic role that SREP can play in developing RES support systems call for a carefull assessment.

V.7. Leverage of investments

Leverage ratio is defined here as the ratio of the value of grant equivalent to the value of total investments in renewable project. The larger the total investment generated by a unit of grant equivalent the bigger the impact of scarce SREP and other public funds. The best effects are achieved with the leverage ratio of 1:5 – 1:6. Lower ratios typically imply that the grant is excessive and renewable technology is very costly.

Higher leverage typically implies that the grant is insignificant factor in investment decision, i.e. loses its incentive effect and is not needed in the first place.

V.8. Sustainability of subsidized activities

In order to create a sustainable impact the structure of subsidy should encourage commercial replication of eligible projects after public support is withdrawn. SREP subsidies should be part of the early announced and consistently implemented process of phasing out of subsidies over time. This prevents a build-up of unsustainable subsidy expectations among project developers and their equipment suppliers. To deliver sustainable, transformational results SREP should focus on strengthening the entrepreneurial spirit and skills in commercially driven project development, rather than subsidy-driven skills in rent-seeking and in pleasing donors and government officials.

V.9. Administrative costs

The cost of administering a subsidy scheme by public institutions can be very high, in particular for schemes where government agencies allocate resources to, and appraise individual projects, such as CAPEX grants or interest subsidies. Administrative costs can be decreased by standardization or outsourcing, e.g. to private fund managers or financial intermediaries. Another way to decrease administrative burden is to limit the role of the government to setting targets and transparent performance requirements, while leaving individual investment decisions to decentralized transactions by developers and other stakeholders.

V.10. Transaction costs

Transaction costs are non-technical costs of accessing subsidies born by beneficiaries. They are usually higher per unit of electricity produced for developers of small projects. The burden of transaction costs can be alleviated by the intelligent design of a support scheme, standardization of the process and eventually technical assistance for project preparation.

ANNEX I

COMPARATIVE ASSESSMENT OF DIFFERENT SUPPORT SYSTEMS

1. Feed-in tariffs

Fixed feed-in tariffs [65]

Advantages for investors

- Minimize revenue risk as the fixed price is guaranteed for a pre-defined, usually 15-20 years period of time;
- Effective in leveraging investments also in project finance structures;
- Accessible to smaller, distributed generation due to lower transaction costs.

Advantages for governments and donors

- Administrative and transaction costs are relatively low as the design options are well tested in other countries due to widespread application.
- Can be set up to provide technology specific support according to country's preference so that all the RES-E projects would get the same level of rate of return irrespective of technology specific costs.

Weaknesses for investors

- Exposes investors to counterparty political and fiscal risk

Weaknesses for governments and donors

- Fixing prices not quantities can lead to insufficient (below target) renewable energy output or excessive output (e.g. more than the grid and consumers can handle).
- They can be an obstacle to liberalization of the electricity markets in the countries that are planning to do so. When a large share of the electricity generated in a country is sold under the long term power purchase agreements (PPAs) they can restrict competition because they foreclose a significant part of the market from new entrants.
- As a fixed payment does not rely on the electricity price to reward low-carbon generation, flexible plants have no incentive to respond to changes in the electricity price, potentially resulting in inefficient dispatch and higher costs for consumers. PPAs can however include mechanisms to foster flexible plants and peak generation;
- If rates are differentiated by technology they lead to high cost of the total renewable portfolio by encouraging excessive supply of expensive less mature technologies;
- Administrative costs can be high because of adjustments that may be necessary when market reaction is different than expected (too low or too high up-take of investments);
- Tariff setting process is vulnerable to lobbying and rent-seeking.

Feed-in tariffs Premium

Advantages for investors

- Gives renewable power producers an opportunity to learn how to sell electricity on the market and enjoy the up-side when the electricity prices peak.

Advantages for governments and donors

- Better market compatibility than fixed feed-in tariffs, since they do not substitute for market price signals.

Weaknesses for investors

- Premium FiT does not offer security of price, since investors will continue to be exposed to wholesale power price uncertainty.[66]
- It is less effective in attracting small dispersed power producers who would find it too costly and complicated to participate in the wholesale power market.

Weaknesses for governments and donors

- May result in higher overall remuneration level since investors would price uncertainty into the expected premium payment.

FIT with contracts for difference (CfD) [67]

Advantages for investors

- It provides a similar level of revenue certainty to a Fixed FIT, but by setting the level of support according to the average price it preserves the efficiencies of the price signal, i.e. generators will have an incentive to sell their output above the average price as they will keep any upside;
- For investors keep costs down through enabling a lower cost of capital, by providing long-term contracts and greater certainty.
- Help enable smaller generators to enter the market as well as attract a wider range of sources of finance, including more institutional investment.
- The CfD price might be related (on a sliding scale) to the out-turn cost of a project, reducing the developer's risk. [68]

Advantages for governments and donors

- It gives a high level of confidence that the Government's emission reduction targets will be met even in scenarios with lower fossil fuel prices or higher electricity demand, without the need for additional intervention;
- It maintains exposure to the short-term electricity price signal, incentivising efficient operational decisions by generators, which also contributes to security of supply;
- It works well with the carbon price – providing a natural stabilisation mechanism which avoids excess rents and thereby keeps costs down.
- It retains a link to the wholesale electricity price, thus maintain incentives for efficient dispatch.[69]

Weaknesses for investors

- CfD does not remove off take risk. A generator may not find a buyer for their electricity.
- Not suitable for smaller generators.

Weaknesses for governments and donors

- It is inherently more complex than a simple FiT, which may create a barrier to entry.[70]

Auctioned FITs

Advantages for investors

- Lower risk due to guaranteed off-take at a fixed or transparently indexed price and no exposure to competition.

Advantages for governments and donors

- Competitive auction of PPAs can be an effective instrument to discover true cost of renewable generation.
- May reduce the FIT level needed to support a given volume on renewable energy and thus lower the burden on consumers.

Weaknesses for investors

- Higher transaction and entry costs compared to standard FIT;
- Less suitable for smaller generators;
- Exposes investors to counterparty political and fiscal risk .

Weaknesses for governments and donors

- Higher transaction costs compared to standard FIT;
- Share the same market incompatibility and inefficiency issues as fixed FIT;
- Competition in auction may lead to squeezed generators margin and non-delivery of the projects that win the tenders. Design of auction is crucial to mitigate this risk.[71]

2. Quota-based systems such as renewable portfolio standards or tradable green certificates.

Advantages for investors

- Renewable power producers can learn how to sell electricity on the market and enjoy the upside of the peak electricity prices.

Advantages for governments and donors

- They are more assuring that any chosen target quantity of renewable energy is delivered by a date chosen by regulator.
- Quota can be easily coupled with certificates trading scheme which gives vast amount of flexibility to distribution/supply companies in meeting targets (own generation, purchase of certificates from independent producers, import of renewable electricity from other jurisdictions).
- Because of this flexibility TGC systems allow for meeting the target at the lowest portfolio cost.
- Can be gradually phased-in over time with pre-announced schedules allowing also for inter-temporal cost-optimization.

- Once established, quota schemes tend to be bureaucratically simple with low administration costs especially compared to the investment subsidies (grants, soft loans etc.). Investment and pricing decisions are made through negotiations between companies themselves.
- TGCs can be better integrated into the liberalised electricity markets as they do not weaken the underlying wholesale electricity price signals.

Weaknesses for investors

- While offering more certainty about the quantity of renewable energy, they leave the price of energy volatile, subject to market and regulatory risks. In order to prevent the excessive price hikes TGC systems usually introduce penalty prices which can be paid in lieu of surrendering a certificate. It works effectively as a price ceiling for green certificates. From the point of view of investors it is the risk of price falling below the level that would allow to recover long-run costs. Therefore developers are often charged more for borrowing capital and have to charge more for the power they produce. Some authors and market participants noted that projects in UK (under the ROC system) tend to be more expensive than in Germany or Denmark under the feed-in tariff. It is not clear however whether this is applicable to the nature of TGC systems as many analysts of the ROC scheme point out that the larger risks are associated with location and permitting delays and well structured projects could raise finance despite ROC's price volatility. [72] The EBRD assessment of support systems in Germany and Bulgaria (FiT) with Poland and Romania (TGCs) found no correlation between form of support system and total level of support. In fact technology neutral TGCs seem to be more cost-effective on a portfolio across all revewables, because they do not favour expensive technologies, such as solar PV. However, green certificates can be designed with technology specific multipliers and blended with other subsidies, that significantly increases total cost of support.

Weaknesses for governments and donors

- A flip side of cost-effectiveness is that quota systems are less effective in fostering diversification among variety of renewable technologies. This is because profit-maximizing investors facing a single market price for a technology neutral certificate tend to flock to the least-cost portfolio of projects to generate them. [73] Some governments and developers of certain technologies perceive it as a drawback[74] while poor countries and economists tend to enjoy it.
- Under the intensive competition for cutting costs in the TGC systems most projects tend to be large, commercial scale wind, biomass and hydro. For example in US RPSs tend to favour vertically integrated power utilities and large generating companies and were ineffective in supporting small-scale residential renewable technologies (small scale wind or residential roof-top solar).[75] It was also the case in Italy and UK, where feed-in tariffs for residential solar roof-top PV installations were eventually added to the TGC system together with net metering to induce small-scale renewable projects. Technology neutral FITs or TGC schemes can also be designed to attract independent power producers, such as in Poland where creditors provide experienced independent producers with relatively long-term and cheap finance against long-term agreements to off-take certificates and electricity. Small producers under the TGC schemes can gradually enter the market through commercial aggregators who will emerge on the market.

3. Investment grants and rebates

Advantages for investors

- Non-returnable, risk free upfront payment; reduces borrowing needs;
- Off-balance sheet financing.

Advantages for governments and donors

- Transparent, explicit form of subsidy;
- Opportunity to disburse funds quickly.

Weaknesses for governments and donors

- Large, short term expenditure from a budget;
- Project performance risk born mainly by the government;
- Incentives to inflate project cost/borrowing (if grant linked to project cost/loan amount);
- High administrative costs.

Weaknesses for investors

- Need to raise matching finance;
- Exposure to due diligence by fiscal authorities;
- High transaction costs.

Many weaknesses can be addressed by appropriate grant structuring. Project performance risk can be mitigated by linking grant to project outputs rather than to project costs or loan amount (result-based financing RBF or output-based aid OBA). Grant can be structures to "buy" external benefits delivered by a project during the temporary absence of carbon pricing. Most of the new EBRD sustainable energy financing facilities are structured to pay for the value of emissions displaced by the renewable project. Alternatively for smaller projects financed through private financial intermediaries grants can be calculated as a present value of additional payments for each unit (in kWh) of expected electricity production.

Administrative costs can be decreased by outsourcing due diligence, verification and reporting to independent consultants through technical assistance grants (with adequate provision to mitigate conflict of interest like in EBRD Sustainable Energy Financing Facilities[76]). Technical assistance, standardization and streamlining of procedures and paperwork can also significantly reduce the transaction costs associated with additional monitoring, verification and reporting requirements for the grant co-funded projects.

Grants can be structured to leverage and crowd-in sustainable commercial finance if they are small in relation to project cost, linked to external benefits of the projects and have phase-out schedule expected by the market. Otherwise grants may create subsidy dependence in a sector, which delays investments, as investors queue for limited grant budget instead of raising funds on a market for profitable projects. Once a grant budget is exhausted, and unsatisfied investors expect it will be replenished on similar (or more generous) terms, they would not resume negotiations with commercial financiers, but instead wait to try again in future. During the investment planning mission the EP should agree with the government on the grant phase-out schedules, which can be different for different levels of development of financial markets, different for on- and off-grid applications and other economic and market conditions.

4. Concessional loans

Advantages for investors

- Access to low-cost; long term borrowing to cover majority of the project costs.

Advantages for governments and donors

- (Partial) replenishment of the government funds from loan repayment;
- Enhances financial discipline of beneficiaries not exposed to borrowing before.

Weaknesses for governments and donors

- Credit risk born by the government agencies not equipped to manage it;
- Very high administrative costs (may be decreased with outsourcing);
- High risk of crowding-out commercial finance from the eligible sector.

Weaknesses for investors

- Need to raise matching equity (if required by lender);
- On balance sheet finance – creates liability that limits debt capacity;
- Credit capacity and collateral requirements (unless project finance structure);
- Exposure to due diligence by fiscal authorities;
- High transaction costs.

Government agencies, unlike commercial banks, do not have legal instruments and institutional capacity to evaluate and manage credit risk. Outsourcing of lending activity to state owned development banks or specialized agencies or environmental funds transfers administrative burden without necessarily decreasing it. Many of these institutions have not established any retail delivery mechanisms like commercial banks. The lack of infrastructure and experience is often covered with risk aversion, over-collateralization and cumbersome procedures. Few countries can use services of well established micro-finance institutions or special purpose funds that can efficiently reach small renewable project developers or effectively manage project finance products. Some international financial institutions have this capacity and can provide such services to the governments under the international public law agreements, blending domestic resources with international instruments, such as CTF/SREP.

SREP Financing Modalities paper argues (after ODI 2009[77]) that there is a financial case for deploying SREP funds as concessional loans instead of grants if the project rate of return is higher than the investors' hurdle rate of return, because the NPV of a project with a loan is higher than NPV with a grant.[78] This argument, while arithmetically correct, overstates the case for the soft loans. First it requires an assumption about the threshold hurdle rate which in reality will vary from investor to investor because their different WACCs and risk tolerance. Second, and most important, a concessional loan involves much higher risk of crowding-out commercial finance than a grant. As a lending product that is typical for the banks it is in direct competition with the lending products available on the market.

Financing Modalities state that the key determinant in selecting the appropriate subsidy instrument is access to finance in the targeted sector. "*With well functioning financial and capital markets, the credible* *promise of future results-based payments could allow project developers to borrow for upfront investment cost"...*[79] The document does not predetermine whether project developers would borrow from SREP or from commercial lenders. Therefore, SREP investment program missions should conduct a thorough sounding of the financial market to determine the appetite of commercial lenders to finance renewable energy projects, as well as pricing, maturities, collateral requirements and other terms. If there is a potential to raise commercial debt, SREP intervention in the form of a concessional loan would crowd-out commercial lenders from the eligible renewable energy market segment. In certain cases concessional loans can be structured to leverage commercial debt through syndication or through junior/subordinate structure. The former one requires liquid, advanced and risk taking financial markets. The latter reduces risks to commercial lenders (as the SREP loan would be subordinated to commercial debt), however, it is administratively difficult to manage by IFIs.[80]

VI.5. Risk sharing instruments

Advantages for investors

- Reduces cost of borrowing and improved access to finance for project owners;
- First loss guarantee treated like quasi equity by financiers;
- Allows financial institutions to increase of portfolio of renewable projects.

Advantages for governments and donors

- High leverage and strong crowding-in of commercial finance;
- Credit risk shared by the government agencies with private sector.

Weaknesses for governments and donors

- High administrative costs (may be decreased with outsourcing);
- High risk of crowding-out commercial finance from the eligible sector.

Weaknesses for investors

- Potentially increased transaction costs and fees;
- Exposure to due diligence by fiscal authorities.

5. Tax credits

Advantages for investors

- Can be used to either make a larger down payment above the lenders' requirements, cover closing costs, or buy down their interest rate.

Advantages for governments and donors

- Politically easier to introduce as an indirect, non-transparent subsidy;
- Deferred fiscal liabilities, distributed over a longer period of time;

- Transfers fiscal burden on political successors.

Weaknesses for governments and donors

- Requires sophisticated tax administration;
- Non-transparent form of subsidy.

Weaknesses for investors

- Need to raise matching finance;
- Exposure to due diligence by fiscal authorities;
- High transaction costs.

ANNEX II:

GRANT EQUIVALENT OF SUBSIDY INTENSITY: CASE OFGRANTS AND CONCESSIONAL LOANS

The ***grant equivalent*** measures amount of money that needs to be handed to the beneficiary upfront to make her/him indifferent between this payment and a given concessional loan, feed-in tariff or risk cushion. In the case of loans, ***grant element*** is referred to as a grant equivalent shown as percentage of the loan's face value, but it can be accordingly presented for loan guarantees or other forms of subsidy.

For concessional loans for example, the grant equivalent is calculated as the difference between the present value of the concessional loan and the present value of a standard commercial loan.[81] Therefore, the concessional loan is compared to a reference loan and the grant equivalent reflects the benefit from the subsidized rate. Another way of obtaining the grant equivalent is to only assess the present value of the concessional loan with an adjusted discount rate. The discount rate then reflects the commercial interest reference rate (CIRR) and therefore the benchmark. This approach is often referred to as the IDA method and is used by the World Bank and the IMF that also provide grant equivalent calculators in the internet.[82]

Both methods derive the same grant equivalent for annuity (mortgage type) loans. Whenver the debt service profile is different and the details are available, the grant equivalent should be derived by comparing the debt service profile under the subsidized loan and the reference market loan. This allows handling more complex structures, as decreasing or increasing interest rate payments.

ANNEX III

LEAST-COST MIX OF RENEWABLE TECHNOLOGIES

Figure II.1 illustrates the stylised impact of a choice of support instrument on the total principles of the least cost mix of renewable technologies to achieve intermediate various renewable deployment targets, and thus the total cost of support across the whole portfolio of renewable sources.

The dashed red horizontal line represents the prevailing wholesale electricity price on the market. The dashed green horizontal line above represents a “shadow” price of electricity when external costs of thermal and nuclear electricity are included.

The bars represent the total revenues of electricity producers from four renewable technologies – for example small hydro, wind, biomass and solar PV. The height of the bar is the average production costs per MWh and the width of the bar represents the volume of electricity produced.

The shadowed area of the bars covered with diagonal stripes represents the total financial cost of renewable support to consumers or taxpayers. This is the difference between the prices paid to producers and the wholesale electricity price multiplied by the quantity of electricity generation by different technology.

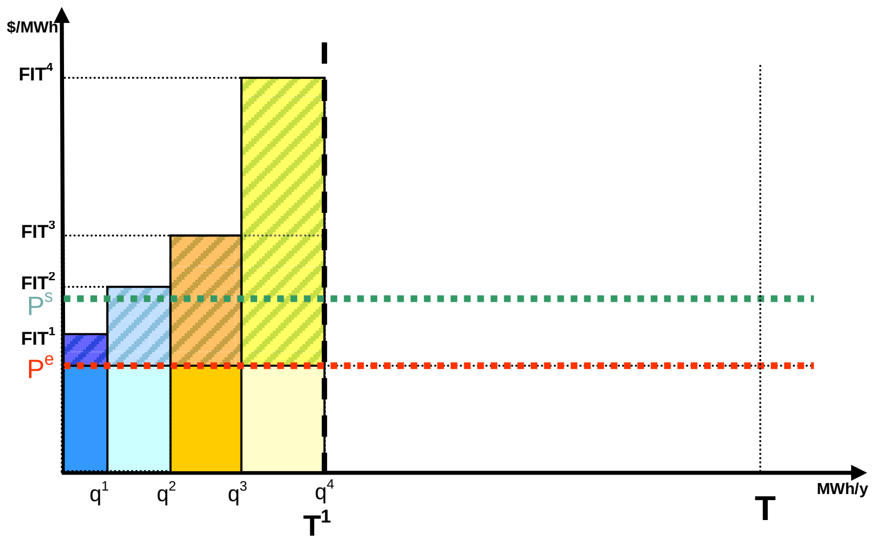
On figure 2a the regulator sets four different FIT rates – each matching the cost of production of different technologies. The regulator is assumed to have perfect information about generation costs. Therefore s/he is able to apply perfect price discrimination between different technologies effectively eliminating any producer surplus – each technology gets the tariff equal to its marginal cost. Expensive technologies are paid higher tariffs therefore they are prominently present in an overall portfolio of renewable technologies delivering together electricity equals T^1 MWh.

In figure 2b the same renewable electricity target is achieved by setting a renewable portfolio obligation at the level of T^1. If the volume of renewable certificates equal to T^1 is issued the equilibrium price of certificate will be set by the cost of marginal renewable technology. Investors flock to cheaper renewable technologies, such as hydro and wind to maximise their profits and increase their supply compared to scenario II1.a. Marginal cost of wind sets the certificate price. The total financial cost of the support (striped area) includes surplus for hydro generators (revenue in excess of production costs). However, because more expensive technologies are not competitive at a certificate clearing price investors are not willing to develop them. Therefore they are not present in the technology mix that delivers renewable production target T^1. Therefore the total financial cost of support is lower in II.1b, than in II.1.a.

The same cost-effective mix of renewable technologies and reduced total financial cost of support can be expected from a technology neutral FIT set at the same level in II.1b as the equilibrium price of green certificates.

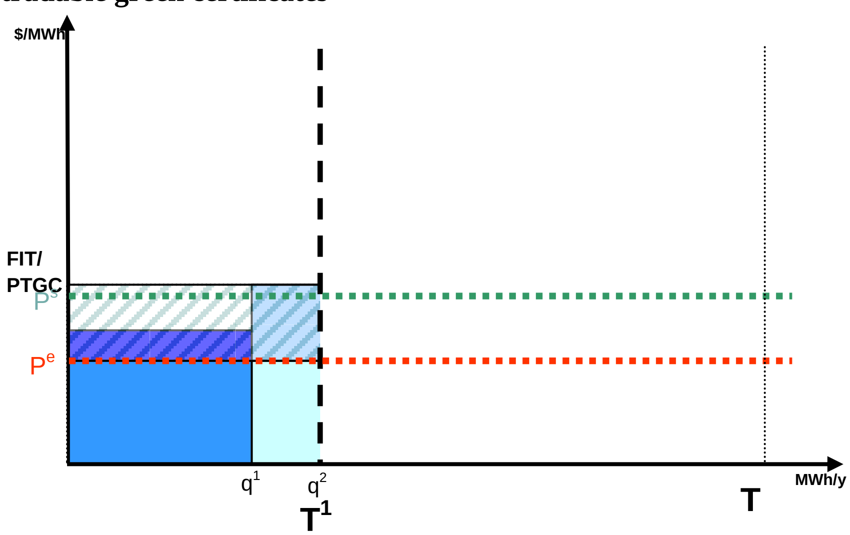
Eventually as the cost of available renewable technologies decreases the support for most cost-competitive technologies can be reduced and gradually removed exposing projects to market risk.

Figure II.1 a. Least-cost mix of Total financial cost of support to renewable energy under renewable technologiestechnology specific FiT



Source: EBRD

Figure II.1.b. Total financial cost of support to renewable energy under technology neutral FiT or tradable green certificates



Source: EBRD

ANNEX IV

LEARNING EFFECT

Advocates of renewable energy argue that even if the early deployment of some renewables looks costly this deployment must be undertaken because it drives long-term cost reduction. The learning curves are often plotted for each technology to illustrate this hypothesis. They show a lifetime cost per unit of energy produced as a function of the deployment volume. Due to this learning effects new techniques, although more costly at the outset, are believed to become cost-effective over time if they benefit from sufficient dissemination. Indeed, historical data for each technology show a strong correlation between increasing volumes of renewable capacity installed and decreasing unit cost of generation.

Three issues, however cast doubt about the learning effect as a justification for accelerated deployment of the high-cost renewable technologies around the world.

- *Coexistence of increased market shares and decreased costs does not necessarily demonstrate that the former caused the latter*. IEA noted that the causality relationship works both ways: when costs decrease, markets increase. [83] Also Nemet in his seminal analysis of learning curves concluded that that "*learning from experience, the theoretical mechanism used to explain learning curves, only weakly explains change in the most important factors—plant size, module efficiency, and the cost of silicon*."[84] , it remains difficult to clearly distinguish between the effects of R&D expenditures market dynamics, technical issues, industry structure and those arising from the scale of deployment.[85]

- *Even if the deployment-led cost reduction hypothesis was true it would not necessarily justify higher grant intensity for high-cost renewable technologies everywhere*. Unit costs are expected to fall as capacity increases around the world. Because renewable technologies are internationally tradable developing countries can free-ride on the support paid by richer countries. All countries can benefit from the knowledge and technology spillover of the R&D expenditures and/or high deployment rates in richer countries. Support for selected high-cost technologies may be justified when a country realistically expect that increased domestic demand will drive the costs of domestic manufacturers down and increase their export competitiveness and eventually development of sustainable competitive domestic manufacturing or assembly capacity.

- *Inappropriate support policies can raise prices*. Normally the learning curves are downward sloping – with time increased deployment is expected to be correlated with a decrease in unit costs. However, figure 4 shows that in the period 2005-2008 the PV learning curve was sloping upwards – violating the learning curve hypothesis. This surprising trend begun soon after generous feed-in tariffs for grid-connected solar PV began in Japan and Germany and followed by Spain and the Czech Republic causing surge in demand for PV investments.[86] This coincided with bottlenecks on the side of manufacturers who eagerly increased the prices to capture their share of feed-in tariff subsidies. Anecdotal evidence from the market suggests that manufacturers were able to charge higher prices to developers of projects in highly subsidised jurisdictions. PV prices remained higher than expected until the joint effect of cuts in subsidies,[87] economic crisis and aggressive entry of suppliers from developing countries (mainly China) made prices fall again. The trend line is on a typical downward slope again but a flatter one than would have been without the events from 2005-2008.

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