

Feed-in Tariff (FIT) – An attractive renewable energy policy support mechanism for the Caribbean

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Agenda

1. Background
2. Key objectives of renewables incentive schemes
3. Introduce FiTs and define key characteristics for success
4. Compare FiTs with other support mechanisms
5. Review of key design features
 - Pros and cons of major design options
 - International best practices in design
6. Case studies
7. Concluding remarks

Background

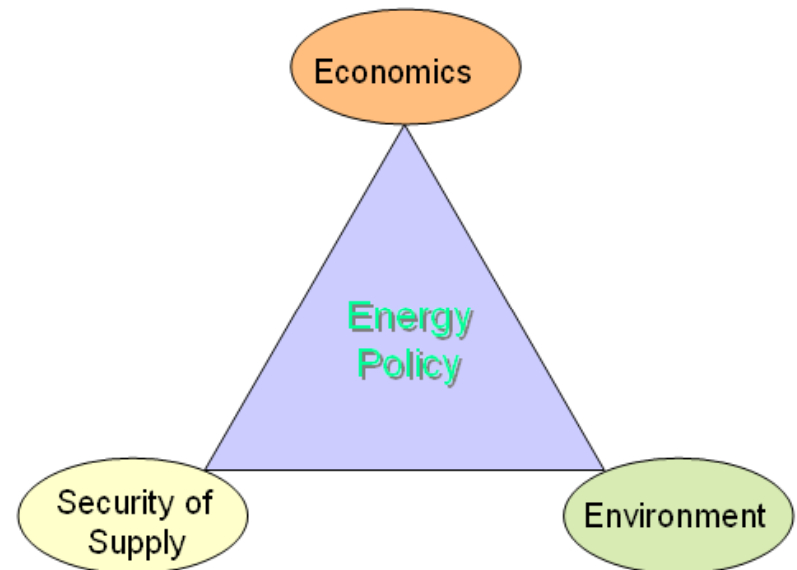
- Renewables costs traditionally outweigh fossil-fuel base counterparts
 - Not considering externalities
- Attractiveness of renewables improved significantly in last few decades
 - Technological innovation and learning
 - Surges in fossil-fuel prices
- Renewables still not competitive and need financial support
 - To make them economically viable
 - To increase their market penetration

Key objectives of RES-E incentive schemes

- Increase market penetration of renewables

Wider policy objectives:

- Environmental imperatives
 - GHG emission reduction
- Security of supply
 - diversification of electricity portfolio
 - Reduce reliance on imported fuel stock
- Economic / industrial policy considerations
 - Create new industries and jobs in the RES-E supply chain
 - Drive technological innovations



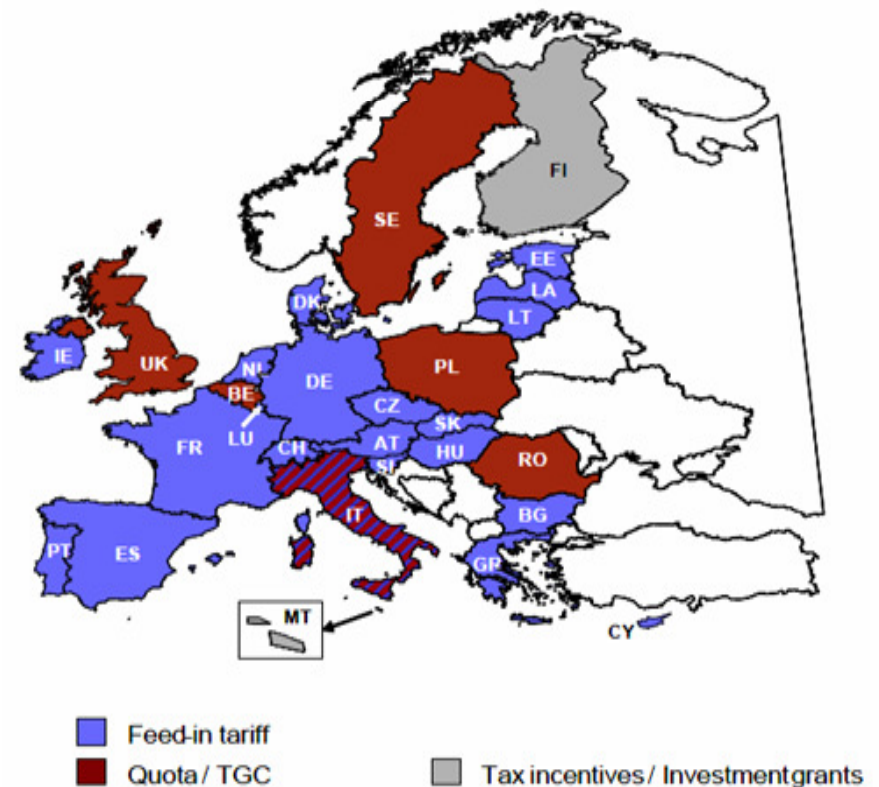
Introduction to Feed-in Tariffs

What is a Feed-in tariff?

- Guaranteed payment to a RES-E plant, usually accompanied by requirement for grid to accept output

Where are they in place?

- Worldwide
- Extensively in Europe
 - 19 of EU-27 countries used FiTs in 2008
 - 6 used Quota obligation with TGC
 - 2 used tax incentive/ investment grants



Key characteristics of successful FiTs

- **Simplicity and transparency**
 - low administrative and regulatory barriers
 - lowers perceived risk and improves investors' confidence and investment security
- **Longevity and consistency/ certainty to investors**
 - stable/ predictable and long term policy framework enhances investment stability
 - provides sufficient revenues to cover power generation costs inclusive of return expectations: appropriate levels of IRR across different investor groups and technologies
- **Minimal cost of deployment and high economic efficiency**
 - cheap to implement and guards against excessive rents
 - remuneration level does not necessarily correlate with policy effectiveness
 - encourages exploitation of the most cost effective resources first (not a must)
 - encourages diffusion of immature and less competitive technologies – learning and scale economics lead to future cost reductions
- **Minimal transaction costs**
 - high compatibility with current market and policy arrangements

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Comparing FiTs with other support mechanisms

Categorisation of RES-E incentive mechanisms:

	Direct		Indirect
	Price driven	Quantity driven	
Investment focussed	<ul style="list-style-type: none"> • Investment subsidies • Tax credit 	<ul style="list-style-type: none"> • Tendering system 	
Generation based	<ul style="list-style-type: none"> • Feed-in tariffs • Net metering • Rate-based incentives 	<ul style="list-style-type: none"> • Tendering system • Quota obligation base on Tradeable Green Certificate (TGC) or not 	<ul style="list-style-type: none"> • Environmental taxes

Investment focus versus generation based mechanisms?

- Generation based preferred: incentivises delivery of electricity to grid

Price driven versus quantity driven?

“...Both sets of instruments have proved effective but existing experience favours price-based support mechanisms.” **Stern Review (2006)**

Comparing FiTs with other support mechanisms (II)

FiT, quota obligation with TGC and net metering are most prevalent RES-E support schemes worldwide

Pros and cons of a FiT

Pros

- Lower risks for investors: **guaranteed fixed payments for fixed periods reduce** volume and price risks.
- RES-E plants are typically **not subjected to balancing risk** and network companies are usually compelled to take all electricity.
- Since different technologies develop at different rates, **application of technology specific tariffs could encourage those far from the market to move closer.**

Cons

- **Interferes with market operation** due to the outputs from RES-E plants being guaranteed.
- **Grid operators must accept all electricity** from RES-E plants, regardless of demand – **can lead to grid management issues.**
- Level of RES-E capacity exploitation depends on investors' response to tariff signals. **Difficult to predict the scale of investments that will be attracted**; hence it is challenging to predict the overall costs of the mechanism in the long term.
- .

Comparing FiTs with other support mechanisms (III)

Pros and cons of a Quota obligation scheme

Pros

- **In theory, should be more effective and cost-efficient** as competition is an inherent feature of the mechanism.
- **It has been suggested that quota based schemes are more efficient in achieving specific goals for renewable energy capacity.**

Cons

- There is **significant risks on volume** (no guarantee to sell all electricity produced, due to competition) **and price** (depend on the market for both electricity and tradable certificates).
- In practice, **increase risk and related additional costs are sufficient to outdo benefits from competition** inherent in system.
- **Mechanism tends to support only the technologies that are close to the market.** Technologies outside the mechanism are likely to become less and less competitive, and thus are never developed. Technological innovation is therefore effectively penalized.

Comparing FiTs with other support mechanisms (IV)

FiT versus Quota obligation (RPS, RO)

“Comparisons between deployment support through tradable quotas and feed-in tariff price support suggest that **feed-in mechanisms achieve larger deployment at lower costs.**”

Stern Review (2006)

“The price paid for wind power under the UK’s RO seems to be significantly higher than the remuneration under the German’s FiT.”

Neuhoff et al. (2004)¹

“...for both PV and wind, the levels of deployment are much greater in the German scheme and the prices are lower than comparable tradable support mechanisms.

Uncertainty discourages investment and increases the cost of capital as the risks associated with the uncertain rewards require greater rewards.”

Stern Review (2006)

Comparing FiTs with other support mechanisms (V)

Pros and cons of a Net metering scheme

Pros

- Similarly to a FiT scheme, **the remuneration under a net metering scheme is guaranteed**, which provides investors' confidence and investment security.
- Scheme **encourages the siting of generators at load centres** which reduce network losses. This also reduces overloads on distribution circuits – deferring need for network upgrades.

Cons

- Since **generation costs typically account for about 3/8 of the retail price of electricity**, it means that the support to a RES-E plant under a **net metering** arrangement, where excess generation is credited at the retail rate, is **extremely generous**. This **makes the scheme cost inefficient relative to FiTs**.
- The approach **reduces a utility's revenue base** and the tax revenue from energy sales, which **could result in the utility being unable to cover its costs**. This effect, which exacerbates with the proliferation of RES-E take up under the scheme, arises because the utility has to build its facilities to be able to meet the entire demands of the system, and the retail rate is typically designed to spread the recovery of the associated investment costs over the entire system energy requirements.

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A key principle underpinning a design consideration

RES-E plants costs dependent on several parameters and characteristics

Inter-
technology
variations

- Wind, solar, biomass, hydro etc.

Intra-
technology
variations

- Onshore vs. offshore wind, solar thermal vs. solar PV, fuel type for biomass plants

Scale

- Economies vs. diseconomies of scale

Local
conditions

- Quality of renewable energy resource (e.g., level of wind speeds at sites etc.)

Major parameter design choices

All FiTs are permutation of three major parameter choices

Fixed vs.
premium tariff

- Fixed tariffs – a fixed overall remuneration independent of electricity market prices
- Premium tariff – a premium on top of electricity market price

Flat vs.
stepped tariff

- Flat schemes: no differentiation by scale, within technology or by local condition (differentiation by technology possible)
- Stepped tariffs implement differentiation by scale and/or by inter-/intra-technology and/or by local condition
- Choice of differentiation:
 - By technology, and within technology (e.g., by type of biomass fuel)
 - By scale
 - By local conditions (quality of renewable resource/ specific location of plant)

Tariff setting/
adjustment
mechanics

- Protocol for setting initial tariffs and revising tariffs
 - what initial level?
 - how often to revise and impact on existing installations?
- Degression? – annual reduction of the tariff level for new power plants – ideally reflects cost reductions due to the experience curve effect

Fixed tariffs

- **Fixed remuneration independent of wholesale price**
 - Fixed tariff without demand orientation (one fixed level of support) – e.g. Germany
 - Demand oriented fixed tariff (e.g. separate support levels for day and night)

Pros and cons of a fixed tariff

Pros

- **High level of certainty** – fixed remuneration that is independent of wholesale price. Certainty reduces the risk and cost of capital.
- **Lowers transaction costs** for generator – no balancing and demand management costs
- **Purchase guarantee for RES-E plants output**

Cons

- **Less demand oriented** – generator has no incentive to produce electricity at peak periods
- In most cases – **higher balancing and grid management costs are socialised to consumers**
- **Less market oriented and hence likely to be more market distorting** if not correctly set

INSIGHT: Consider fixed tariff for non-controllable generation, the extra transaction costs and uncertainty of a premium outweighs grid management benefits

Premium tariffs

- Wholesale price *plus* a set premium
 - Electricity market price plus a set percentage of market price
 - Electricity market price plus a set absolute figure

Pros and cons of a premium tariff

Pros

- **Greater compatibility with liberalized market** – cause less market distortion
- **More demand oriented** – incentivises RES-E plants to supply electricity during peak periods (although operators of wind and solar plants have little influence on supply profiles)
- **Market participation prepares generators in the eventuality that the FiT runs out**

Cons

- **No purchase guarantee and therefore less investment security – offset by higher tariffs**
 - Investors need higher returns to put up with complexity of extracting revenues from many sources and added volatility in wholesale prices
- **Risk of over- or under-compensating plants**
- In most schemes RES-E suppliers have to participate in the electricity market
 - Increases transaction costs – imbalance charges

To mitigate the disadvantages of premium schemes, some schemes have introduced collar minimum and/or maximum

INSIGHT: For controllable generation, a premium tariff may provide the right signals, provided there are minimal transaction costs of participating in the market

Comparing flat tariff vs. stepped tariffs

Flat tariff

- Flat tariff without technology differentiation (one generic support level for all plants irrespective of their characteristics)
- Technology differentiated flat tariff (technology specific set support levels)

Stepped tariff

- Inclusivity/ exclusivity of inter- or intra-technology differentiation
- Inclusivity of either (or both) scale and local-condition differentiation

Pros and cons of stepped tariff in relation to flat tariff

Pros

- **Accounts for effect of scale and other determining factors on plant costs** and enable policy to reflect local conditions in tariff level
- **Minimises risk of overcompensating plants and moderates producer profits**

Cons

- **Potential for high administrative complexity and investor uncertainty**
- **Possibility of perverse scale incentive** (exploiting 2 smaller plants vs. a large one; or at less productive sites) – lead to inefficiency
- **Many different tariff levels may reduce transparency**

INSIGHT: Choose banding, but limited to technology and scale (to avoid complexity), exceptions may include PV (building integrated vs. field systems); biomass (fuel type).

Setting new tariff levels and review of tariffs

Level of initial tariff and review protocol has important bearing on perceived risks and profitability

- Setting the initial tariff
 - as a rate of return equal to a standard investors hurdle rate
 - Average cost of generation plus profit/ Use of reference plant – e.g. Czech Republic
- Protocol for revision
 - Ad hoc (for example, based on regulator's view of FiT performance)
 - Periodic review periods, e.g. every 2 / 3 / 4 years
 - Achievement of specific milestones (e.g.. when a fixed amount of RES-E capacity is added or a set percentage of long term capacity goal reached)

Pros and cons of shorter vs. longer periods of review

Pros	Cons
<ul style="list-style-type: none">• Able to align scheme more closely with policy objectives and with investor sentiment	<ul style="list-style-type: none">• Risk of policy instability – impacts investors• The review process will always be onerous for the regulatory bodies

INSIGHT: The German scheme seems to provide a good model here – regular reviews, with a transparent review process every 3 years and agreed depression levels in between

Setting new tariff levels – degression

- Annual reduction of the tariff level for new power plants
 - ideally reflects cost reductions due to the experience curve effect
 - Degression provides incentives for technology improvements and cost reductions and minimizes risk of over-compensation of projects
- Reflects technological progress and learning process (e.g. economies of scale)
- Implementation of degression
 - Technology specific degression rates vs. generic degression rates
 - Constant rates between review periods vs. rates that vary between review periods (e.g. based on the success or failure to achieve annual milestones)

Pros and cons of including degression

Pros

- Incentives for technological improvement and lowers burden on electricity consumers
- Incentives for early adopters who gain higher tariffs
- Well defined pre-set degression rates provide transparency and investment security

Cons

- Difficult to set appropriate rates due to difficulty of predicting technological learning
- Poorly set lengthy degression rates may reduce flexibility

Secondary parameter design options and issues

Length and term of policy (time frame of support)

- Support period correlate positively with investment security - short support periods typically require other policy commitment or higher rates to minimise investment risk

Deeming and capitalisation

- Deeming future tariff remuneration stream and paying upfront
- Impact on take up: e.g., overcoming high discounting by household sector

Inclusion of scale limit and capacity caps

- Scale limit - the threshold on size of plants for applicability
- Capacity cap – maximum volume of new installations in any year/review period (typically implemented to restrict total cost of the tariff to consumers)

Purchase obligation / forecast obligation

- Purchase obligation compels DNO to purchase RES-E plants output
- Forecast obligation – RES-E generators have to forecast future generation and notify the grid operator, may include imbalance charges

Inflation and exchange rates

- Investor certainty can be improved by including inflation, exchange rates and even materials costs in the FiT

Secondary parameter design options and issues (II)

Bonuses for innovative features

- High energy efficiency power plants (France)
- Repowering of wind turbines (Denmark, Germany)
- Electricity generation during times of high demand (Slovakia)

Grid related issues

- distribution of grid connection and upgrade costs
- Is there a connection obligation? Who pays for the cost of connection?

Administration of scheme – metering, payments

- Responsibility for collecting and distributing money (DNO, supplier, centralized government agency); responsibility for metering? regularity of payment?

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International best practices in design

- Differentiate by technology and scale to reduce rents – stepped tariff
- For non-controllable generation (e.g. wind) usually more appropriate to apply fixed tariff
- Set clear guidelines for review period – timing and impact on existing installations
- Set initial tariff levels to reflect reasonable IRRs for investors based on technology specific costs of generation
- Apply degression to reduce cost of the FiT scheme and encourage technology cost reduction
- Give reasonable length guaranteed payments – reflecting economic lifetime or common duration debt financing

International best practice: FiT characteristics

A well designed FiT ...

- Provides technology-specific support and with respect to the future potential of the technologies
- Is cost efficient and avoids windfall profits
- Can give incentives to RES-E producers to participate in the liberalised power markets
- Sets targets for technological progress
- Can be adjusted to changes in the market situations

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Case studies

A. Germany

B. Spain

C. Portugal

D. Netherlands

World Cup
Prediction?

Germany



Key summaries of FiT scheme in Germany

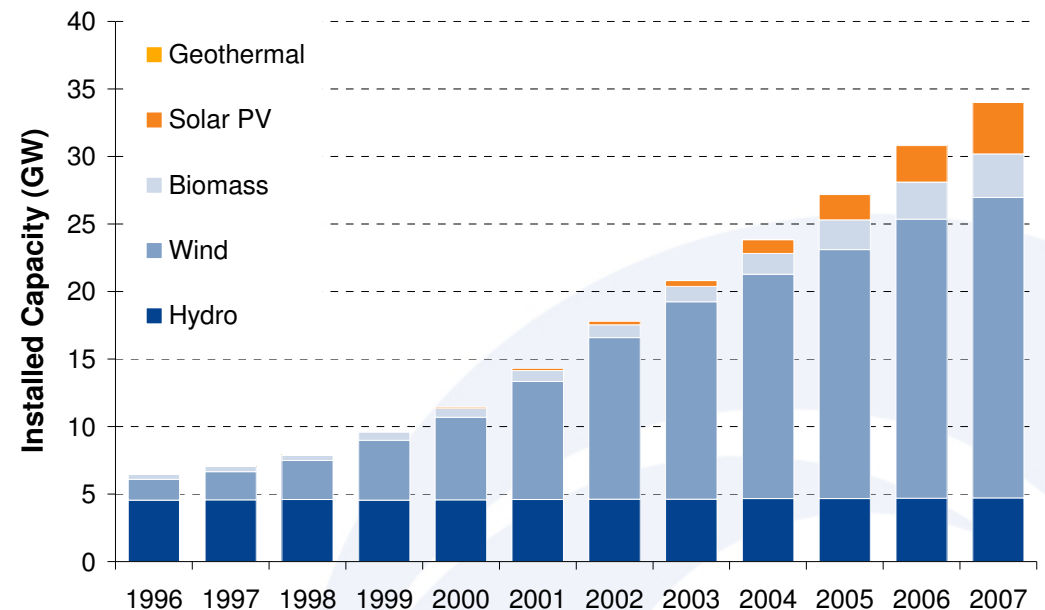
- World leader in wind and solar PV deployment
- FiT is main support mechanism – complemented by abundant soft loans (KfW)
- Utilized since 1991 with amendments in 2000, 2004 and 2009
- Fixed and stepped tariff with degression
- Regular transparent reviews (every 3 years)

Uptake in RES-E between 1996-2007

- 20,700MW – 27.4% annual growth in wind
- 3,787MW – 58.5% annual growth in solar PV
- 2,880MW – 22.2% annual growth in biomass

How to apportion contribution of FIT?

- KfW soft loans programs a major contributor





Some performance indicators

Wider economic benefits

- over 250,000 jobs created (2008)
- ~€24.6 billion turnover from the installation and operation of plants

Investment 'friendliness'

- Extended support of 20 years for most technologies, 30 years for hydro – enhances security
- Scheme simple and highly transparent (e.g. well defined degression rates for the various technologies) – aids confidence
- Moderate IRRs provided – in the range 4-12% (for 2008): based on upper limits of remuneration
- Diverse range of technologies supported

Strengths / weaknesses

- Germany along with Spain ranked as most effective schemes for increasing wind and solar uptake
- Low administrative barrier
 - Most components of scheme highly transparent (e.g., well established degression rates)
- Fairly low financial and social barriers
 - Abundance of soft loans and significant experience/trust among banks and investors
 - Generally high social awareness and acceptance

Low administrative and financial barriers paramount to success



Key summaries of FIT scheme in Spain

- FIT main support mechanism – soft loans, tax incentives and regional investment incentives available to limited extent (most not well know to the general public)
- With the exception of solar PV (which is only supported using fixed tariff), investors have choice between receiving a fixed or premium tariff
- There are min/max caps on the tariff levels for some technologies under the market based option (premium tariff)
- There is no limit on the duration of support, but tariffs reduce appreciably after either 15, 20 or 25 years depending on technology
- Review is linked to the achievement of milestones – 85% of the target for each technology
- Degression recently incorporated – Spanish inflation rate minus a factor; (-0.2%) until the end of 2012, (-0.5%) afterwards



Some performance indicators

Investment 'friendliness'

- Extended support period (no limit) – enhances investment security
- Fairly attractive IRRs (estimated) – in the range 5-22% (for 2008): based on upper limits of remuneration
- Diverse range of technologies supported

Strengths / weaknesses

- World leader in wind and solar deployment with Germany; boom and bust in solar PV take up in recent times (currently over 3000MW installed) - this is due to the non-transparent review procedure
- Fairly low financial and social barriers
 - Soft loans and significant investment incentives
 - Fairly high social awareness and acceptance
- High administrative barriers
 - Scheme fairly complex and provides little transparency

Fairly attractive returns (IRRs) coupled with extended support period and low financial barriers is perhaps key reason behind success



Portugal

Key features

- FiT main support mechanism – combined with investment incentives
- Fixed tariff guaranteed for 15 years – level dependent on many factors:
 - Technology (i.e. technology differentiated)
 - Local RE resource (i.e. stepped tariff)
 - Time of electricity generation (peak/ offpeak) (i.e. demand oriented)
 - Avoided CO₂ emissions and electricity losses
 - Corrected monthly for inflation

$$T_{m,t} = CL_m * [FC + VC + EC * Z_t] * \left[\frac{CPI_{m-1}}{CPI_{ref}} \right] * \left[\frac{1}{1 - GL} \right]$$

- Review occurs when certain capacity of power plants achieved: (PV: 150MW, biomass: 150MW, biogas: 50MW)

Performance, strengths / weaknesses

- Very low financial barrier – investment incentives up to 40% - significant experience/trust among banks and investors
- Very high administrative barrier (high administrative complexity and low transparency)
 - Scheme is based on several factors and is difficult to determine
 - High investor uncertainty and low investment security

Scheme offers high returns and greatly supplemented by investment incentives, yet performance is median



Key features

- FiT main support mechanism – combined with investment incentives
- FiT support mechanism complemented by fiscal incentives for investment and tax exemptions, which ceased in 2005
- Premium FiT guaranteed for 10 years in place from July 2003 (tariff zeroed in August 2006 – new support policy introduced in 2008)
- New ‘sliding premium’ scheme introduced
 - Premium based on average electricity prices and decrease linearly with increasing price

Strengths / weaknesses

- World leader in solid biomass exploitation and, most recently, among the most ‘effective countries in wind and solar PV deployment
- New scheme minimises the risk of over and under compensation to investor and should reduce investor premium/ hurdle rate.

However, this adds to administrative complexity of scheme.

Median policy performance, scheme has undergone perhaps too many changes

Concluding remarks

FiT ...An attractive policy instrument to adapt in region

- RES-E proliferation requires addressing more than just support policy (cost competitiveness):
 - Access to low cost financing
 - Technical issues (capacity etc.)
 - Regulatory, legal and commercial arrangement issues
- Sincerely hope that the Caribbean energy will get 'FiT' for purpose:
 - Secure (reliable)
 - Environmentally friendly
 - Cost effective





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FiT support levels and durations for the selected countries

Tariff level in 2008 [€ Cents/kWh] and duration of support for different technologies

Country		Small hydro	Wind onshore	Wind offshore	Solid biomass	Biogas	PV	Geothermal
Czech Republic	Fixed	10.40 15 yrs.	9.84 15 yrs.	–	10.08 – 16.84 15 yrs.	13.2 – 15.6 15 yrs.	53.84 15 yrs.	17.2 15 yrs.
	Premium	5.60 15 yrs.	7.48 15 yrs.	–	4.96 – 11.72 15 yrs.	8.08 – 10.48 15 yrs.	50.60 15 yrs.	12.9 15 yrs.
Denmark	Fixed	–	–	–	8.0 10 yrs.	8.0 10 yrs.	20.0 – 25.0 20 yrs.	6.9 20 yrs.
Germany ¹⁾	Fixed	7.65 – 12.67 20 yrs.	9.2 20 yrs.	13.0 - 15.0 20 yrs.	7.79 – 22.67 ²⁾ 20 yrs.	7.79 – 29.67 ²⁾ 20 yrs.	31.94 – 43.01 20 yrs.	10.5 – 20.0 20 yrs.
Netherlands	Fixed	–	–	–	14.7 10 yrs.	–	–	–
Portugal	Fixed	7.5 – 7.7 15 yrs.	7.4 – 7.5 15 yrs.	7.4 15 yrs.	10.2 – 10.9 15 yrs.	11.5 – 11.7 15 yrs.	31 – 47 15 yrs.	–
Spain	Fixed	7.8 25 yrs.	7.3 20 yrs.	–	14.6 – 15.9 15 yrs.	8.0 – 10.8 15 yrs.	23.0 – 44.0 25 yrs.	6.9 20 yrs.
	Premium	2.1 – 2.5 no limit.	2.9 no limit	14.1 – 16.4 no limit	10.0 – 11.5 no limit	9.4 no limit	–	3.8 no limit

1) For installations commissioned 2009 according to the new EEG from June 2008

2) Maximum value is only available if all premiums are cumulated (premiums for innovation technologies, CHP, sustainable biomass etc.)

Source: Fraunhofer and EEG