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Environmental Policy Research Centre

Forschungsstelle für Umweltpolitik

Design of feed-in tariffs in emerging economies and developing countries

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Feed-in tariff design for developing countries and emerging economies

FiT design for developing countries

- Generally, feed-in tariffs are very flexible and can be implemented in monopolized and liberalized energy markets
- However, certain design option have to be implemented or adjusted:
  - Capacity caps (cost control)
  - Financing mechanism (burden sharing)
  - Local content requirement (national industry)
  - Combination with CDM mechanism
- Feed-in tariffs can also be designed to support renewable energies in off-grid areas (mini-grids)

Capacity cap

- Capacity cap might be necessary to control costs (number of projects need to be limited)
- To control installed capacity (in line with central planning in monopolized electricity markets)
- E.g. tariff payment for first 400 MW wind energy, first 100 MW geothermal, and first 50 MW solar PV
- In this scenario: Project size should also be limited
- Application process needs to be regulated ("first-come, first-served")

Capacity cap

- Disadvantages:
  - "Stop-and-go" investment cycles – difficult to establish a national industry (similar to tender)
  - Unsustainable market development
- Can be avoided with long-term caps
- Legislator should anticipate what will happen when the cap is reached
- I.e.: Review "cap" once 80 percent of target/cap are reached

Local content requirement

- Several countries have introduced local content requirements in national support mechanisms, i.e. obligations to produce a certain share of renewable energy equipment locally/nationally (e.g. Spain; China; India; Chubut (Argentina); Ontario, Canada)
- These requirements can be implemented in national feed-in tariff mechanisms
  - Establish a national renewable energy industry
  - Take advantage of positive macro-economic effects
- Problem: potential confliction with international trade rules (WTO)

Local Content Requirement in Chubut (Arg)

- Province in Argentina:
- Wind energy law 2005, Article 4, states:
- "... to enjoy this benefit, the wind mills installed have to comply with a timeline detailed further below of including components made or assembled in the Province of Chubut:

a) As from 1 January 1999: 10%

b) As from 1 January 2001: 30%

c) As from 1 January 2003: 60%

d) As from 1 January 2005: 80%

e) As from 1 January 2007: 100%"

- Outcome: low incentive and rigid timeline impended wind power development in Argentina

Local content requirement Ontario

- Local content wind: 25%; 50% in 2012
- Local content solar: 40-50%; 60% in 2011

Local content requirement Ontario

- Complex definitions needed (Ontario): Solar PV

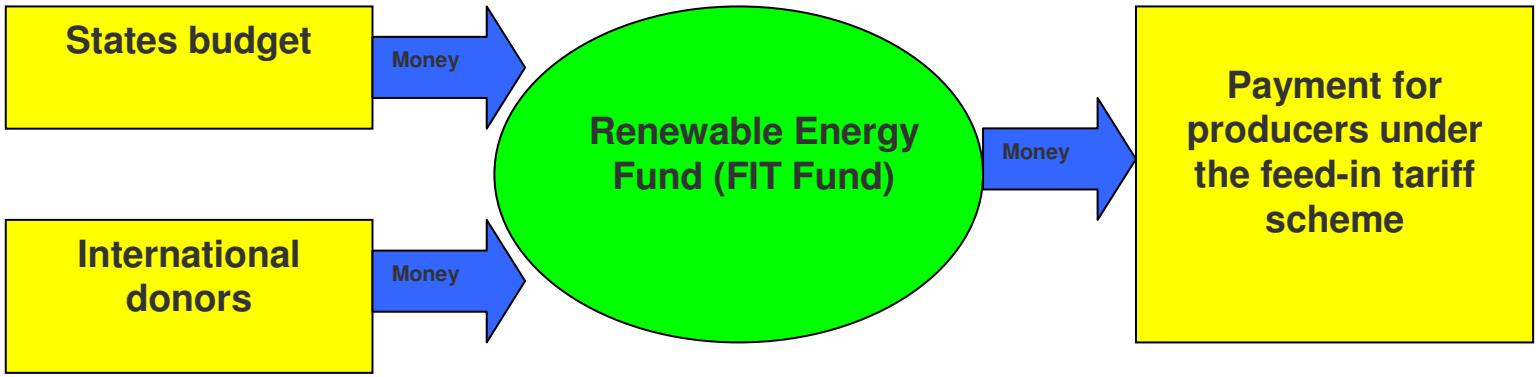
Designated Activity	**Required Percentage**
Silicon that has been used as input to solar photovoltaic cells manufactured in an Ontario refinery.	10%
Silicon ingots and wafer, where silicon ingots have been cast in Ontario and wafers have been cut from the casting by a saw in Ontario.	12%
The crystalline silicon solar photovoltaic cells, where there active photovoltaic layer(s) have been formed in Ontario.	10%

Local content requirement Ontario

Solar photovoltaic modules (i.e. Panels), where the electrical connections between the solar cells have been made in Ontario and the solar photovoltaic module materials have been encapsulated in Ontario.	13%
Inverter, where the assembly, final wiring and testing has been done in Ontario.	9%
Mounting systems, where the structural components of the fixed or moving mounting systems have been entirely machined , formed or cast in Ontario. The metal for the structural components may not have been pre-machined outside Ontario other than the peeling/roughing of the part for quality control purposes when it left the smelter or forge. The machining and assembly of the mounting system must entirely take place in Ontario (i.e. bending, welding, piercing and bolting).	9%
Wiring and electrical hardware that is not part of other Designated Activities (i.e. items 1, 2, 3 and 5 of this table) sourced from an Ontario Supplier.	10%
All on-site and off-site labour and services. For greater certainty, this designated Activity shall apply in respect of all Contract Facilities.	27%
Total	100%

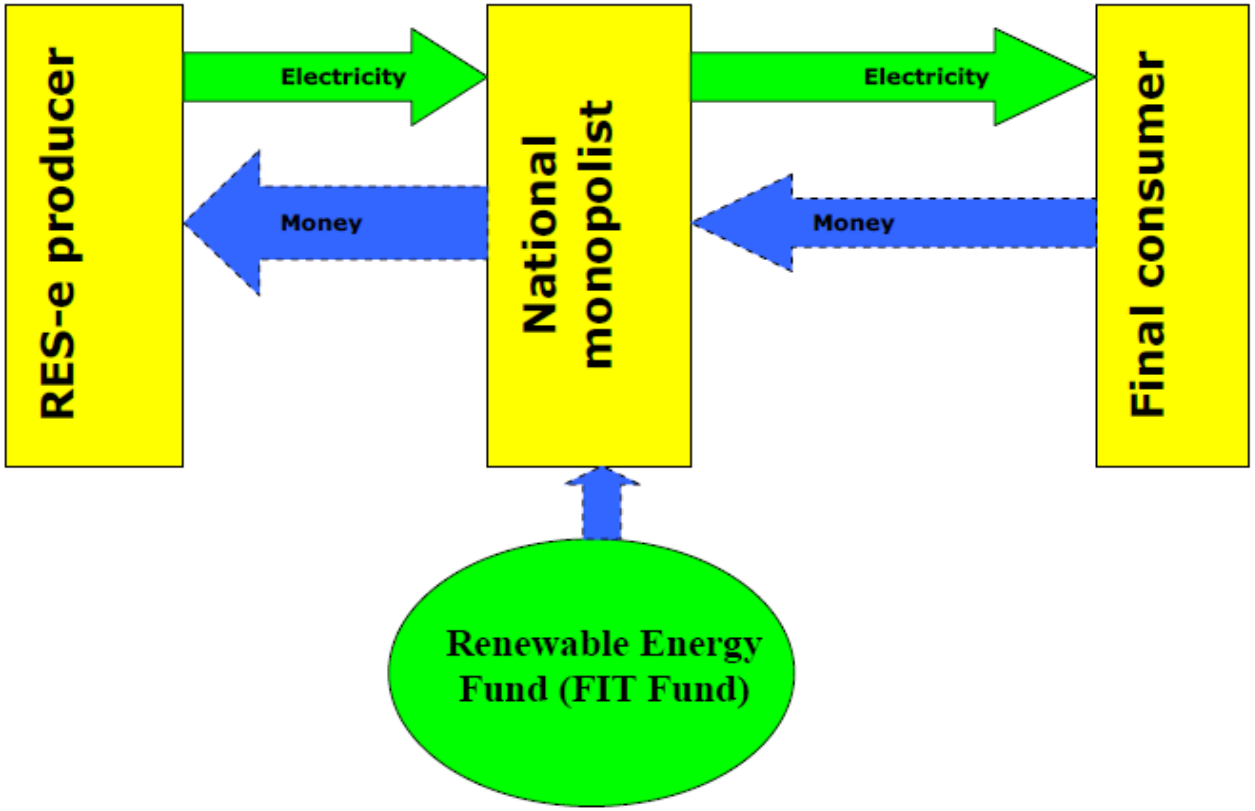
Feed-in tariff fund

- Financing might have to be modified as not all costs can be transferred to the final consumer (regulated tariffs)
- Additional cost might have to be (partially) financed via a feed-in tariff fund/Renewable Energy Fund



Feed-in tariff fund

- Malaysia (plans for 2011): Partially financed via electricity price and partially via Fund

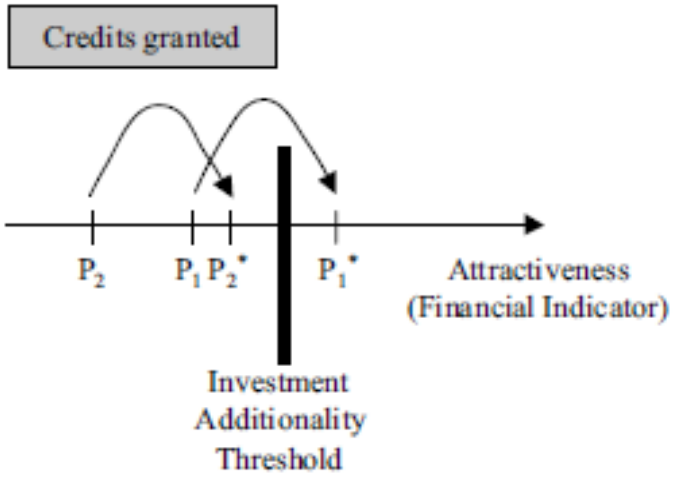


Feed-in tariff fund

- Problems: Money needs to be provided for a long period of time (payment duration 15-25 years) - accruals for 15-25 years?
- Challenges:
  - Who manages the fund?
  - Little experience internationally, so far.

Combining FiT and CDM

- Trading emission reduction units on the international carbon market under Kyoto protocol
- "Additionality" = Project is only eligible under CDM if it would not have been implemented anyway (i.e. without carbon trading financing)



Source: Bode & Michaelowa 2003

Combining FiT and CDM

- This rule created conflict with support mechanisms for renewable electricity (e.g. inclusion in baseline assessment?)
- Now: Support under renewable energy policy instruments is not included in baseline assessment (no more conflict)
- Problems with CDM:
  - High administrative costs – therefore focus on large scale projects
  - Fluctuation of certificate price (see quota based mechanisms)
  - Post-Kyoto period (what happens after 2012?)

  → Incomes from CDM are normally not taken into account when calculating the tariff level (see South Africa).

Case studies from Africa

South Africa and Kenya

- Tariff calculation based on generation costs
- Payment duration: 15-20 years
- No tariff degression
- Eligibility of mature technologies (wind, hydro, biomass)
- South Africa: CSP (good conditions)
- Kenya: Geothermal = cheapest source for electricity (no support needed)
- Capacity caps

Tariff regime in Kenya

Technology	Tariff	Maximum size of power plant
Wind	9 US cent/kWh	50 MW
Biomass (firm)	7 US cent/kWh	40 MW
Biomass (non-firm)	4.5 US cent/kWh	40 MW
Hydro (firm)	8-12 US cent/kWh	500 kW – 10MW
Hydro (non-firm)	6-10 US cent/kWh	500 kW – 10MW

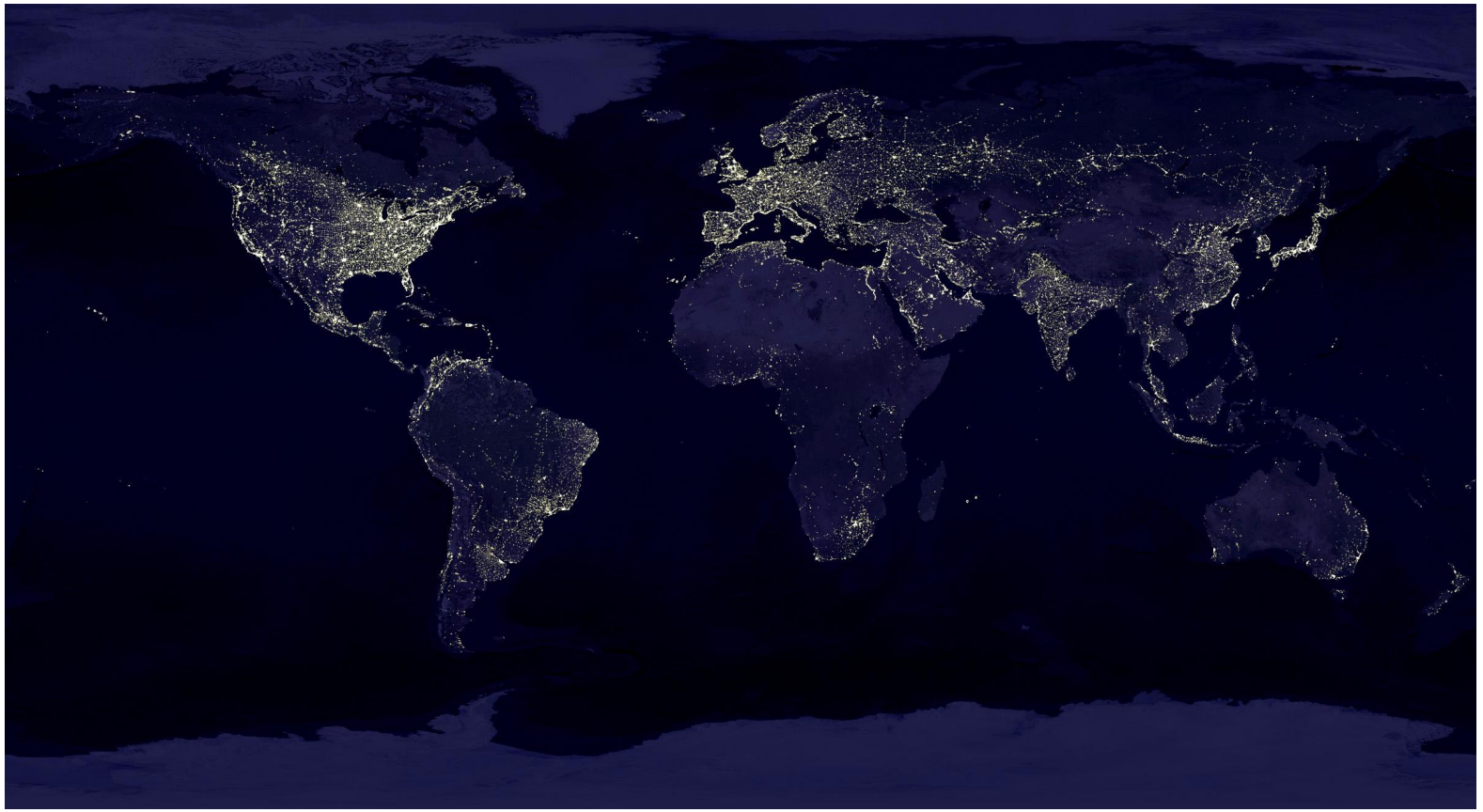
Tariff regime in South Africa

Technology	First tariff proposal (2008) in Euro cent	Tariffs as approved in 2009 in Euro cent
Landfill gas	3.3 €cent/kWh (43.21 c)	7.5 €cent/kWh (90 c)
Small hydro (less than 10 MW)	5.7 €cent/kWh (73.76 c)	7.8 €cent/kWh (94 c)
Wind power	5.1 €cent/kWh (65.48 c)	10.4 €cent/kWh (1.25 R)
Concentrating Solar Power (CHP)	4.7 €cent/kWh (60.64 c)	17.5 €cent/kWh (2.10 R)

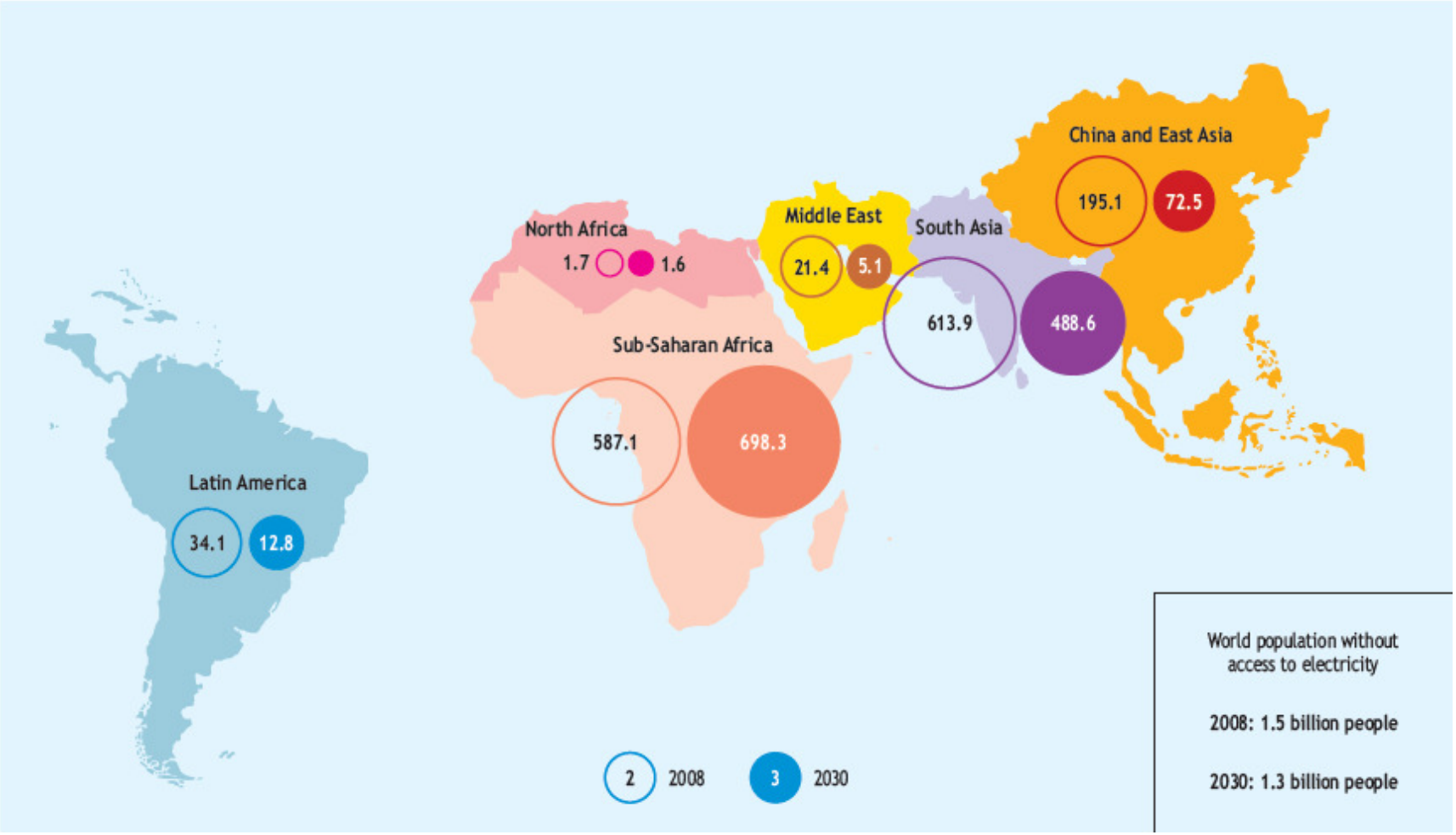
Feed-in tariffs for mini-grids

Rural Electrification

- Renewable energy deployment for rural electrification
- 1.6 billion people world-wide have no access to electricity



Number of people without electricity access



IEA 2009 (WEO)

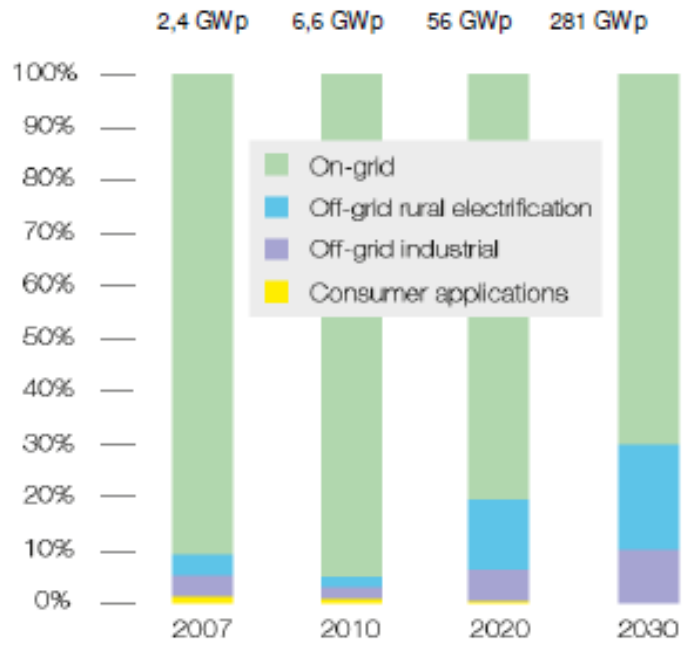
Rural Electrification

- World electricity demand is expected to double by 2030 (highest increase in developing countries)
- Most developing countries have very good natural conditions for renewable energy sources
- Important piece of the puzzle in combating global climate change

Off-grid solar PV market

Off-Grid is a future market

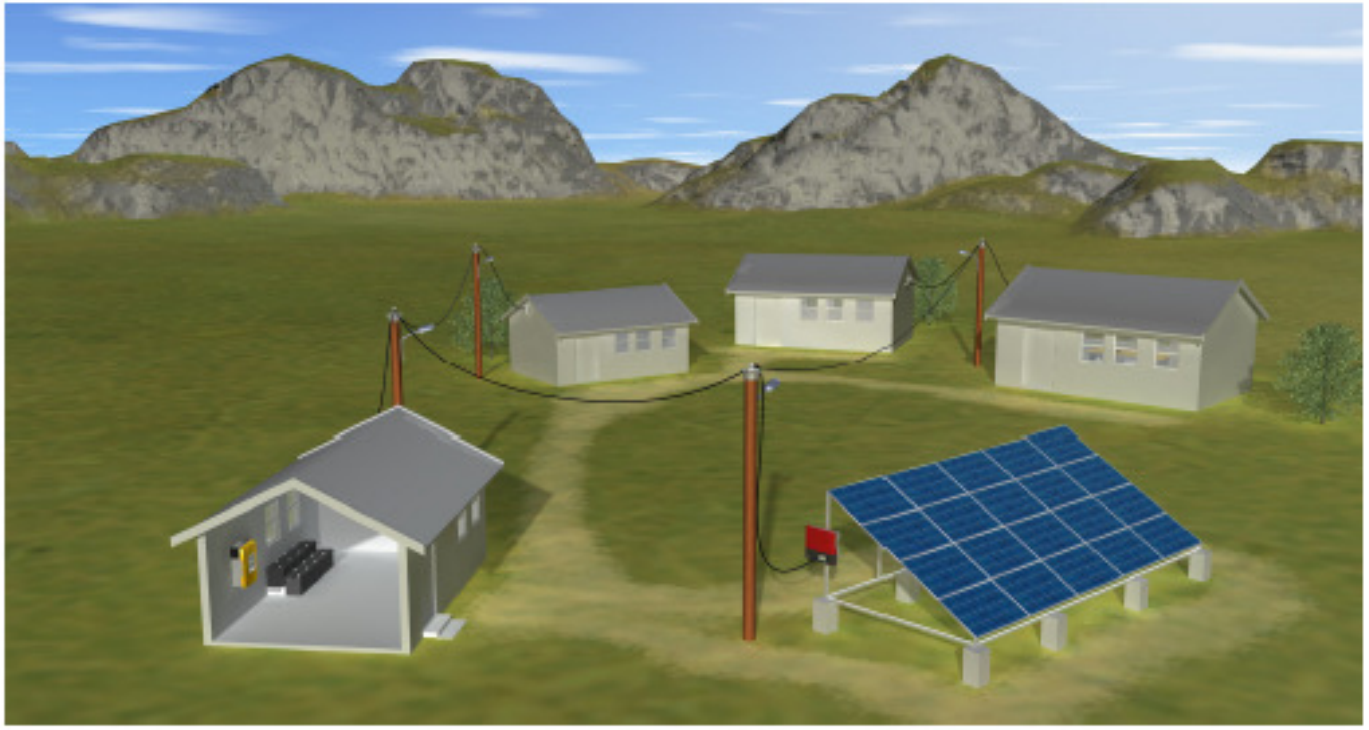
- EPIA/Greenpeace Prognose up to 2030:
  - 105...281 GWp/year
  - 30 % for Off-Grid sector



Annual installed power [Source: EPIA/Greenpeace]

Renewables and Mini-Grids

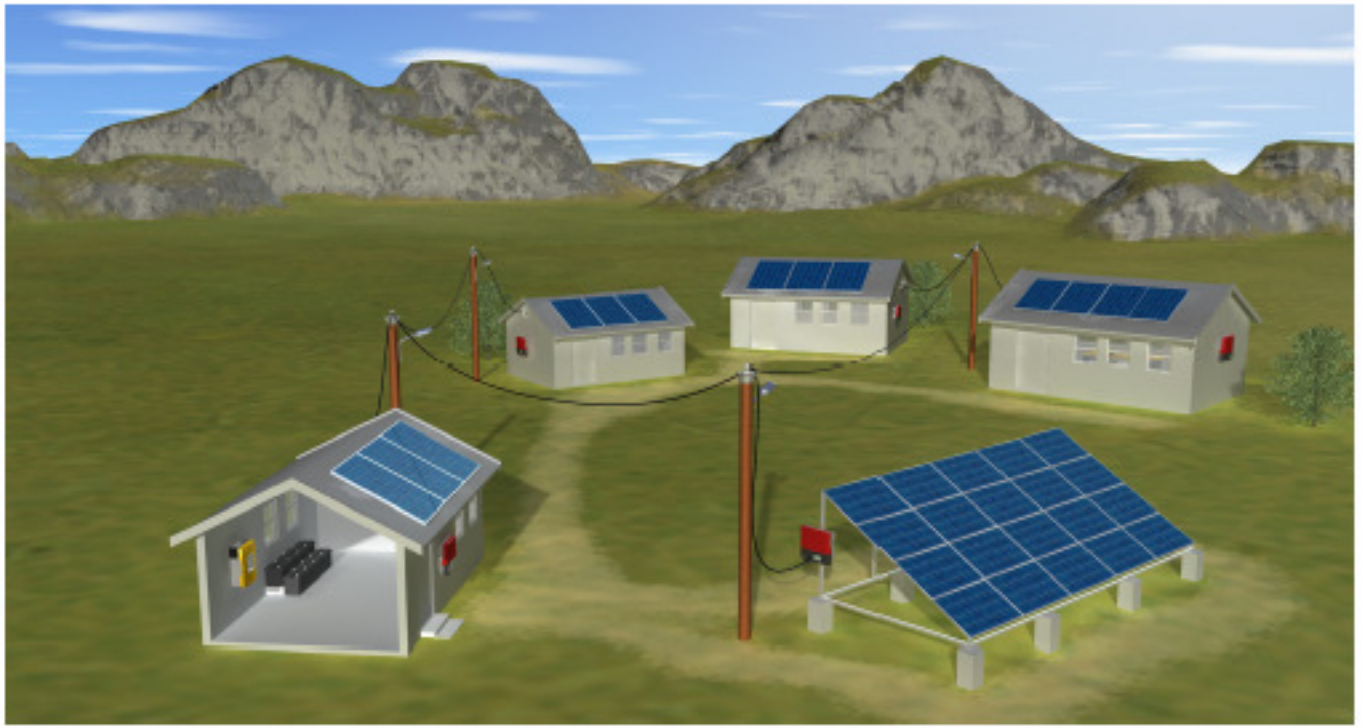
Modular energy supply



Source: ARE & SMA 2009

Renewables and Mini-Grids

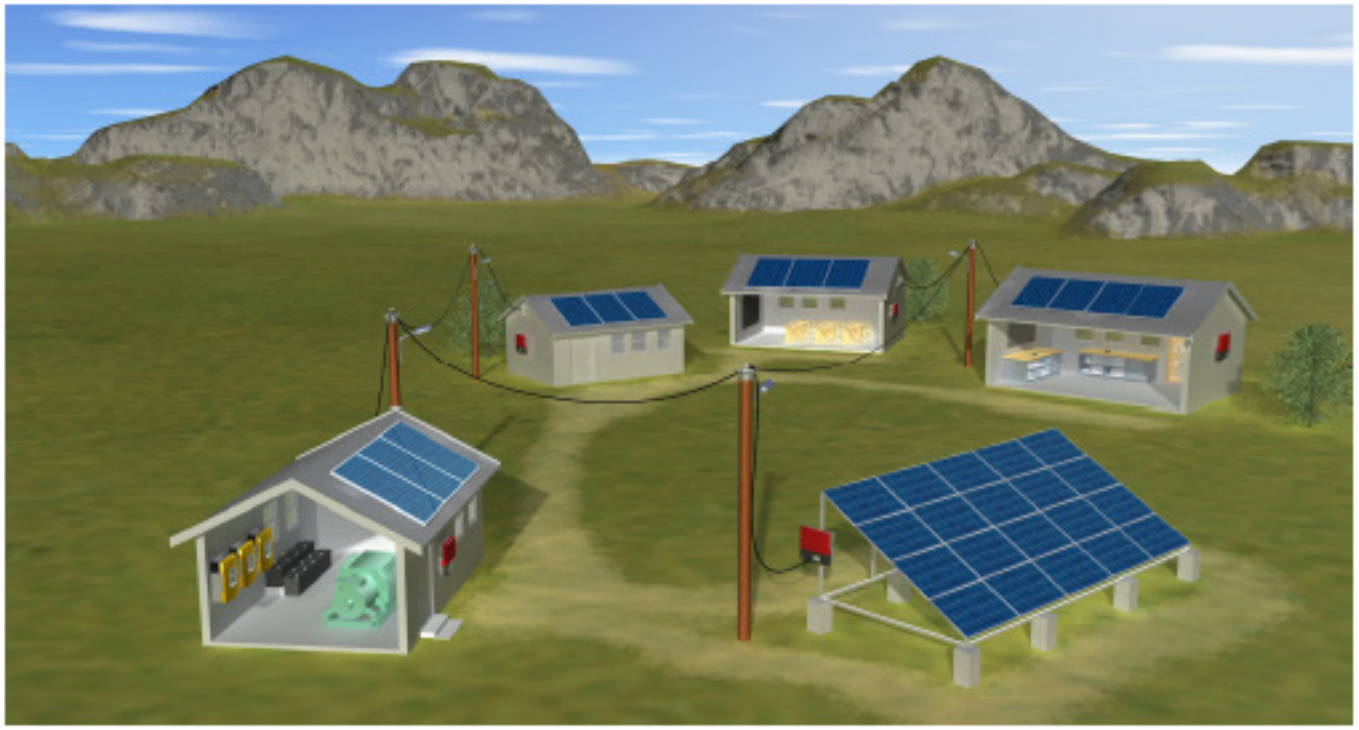
Simple enlargement



Source: ARE & SMA 2009

Renewables and Mini-Grids

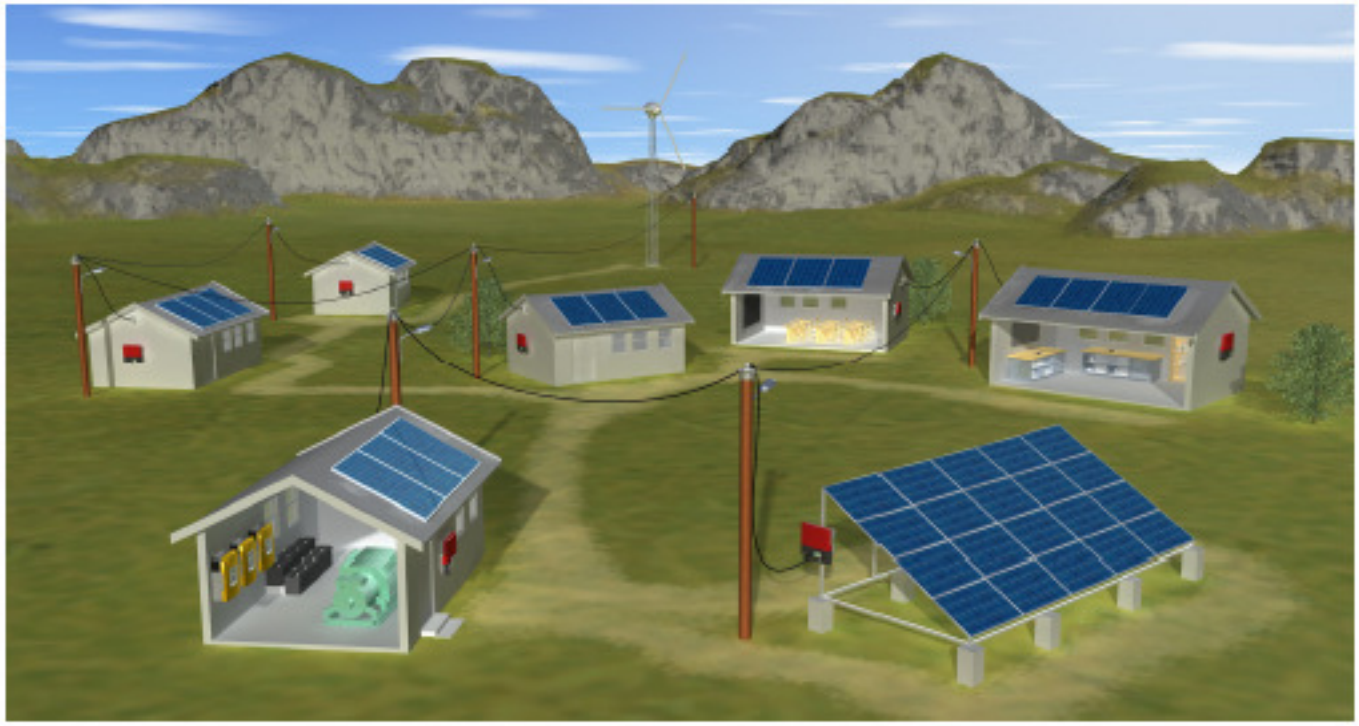
Higher flexibility by coupling all consumers and generators on AC bus line



Source: ARE & SMA 2009

Renewables and Mini-Grids

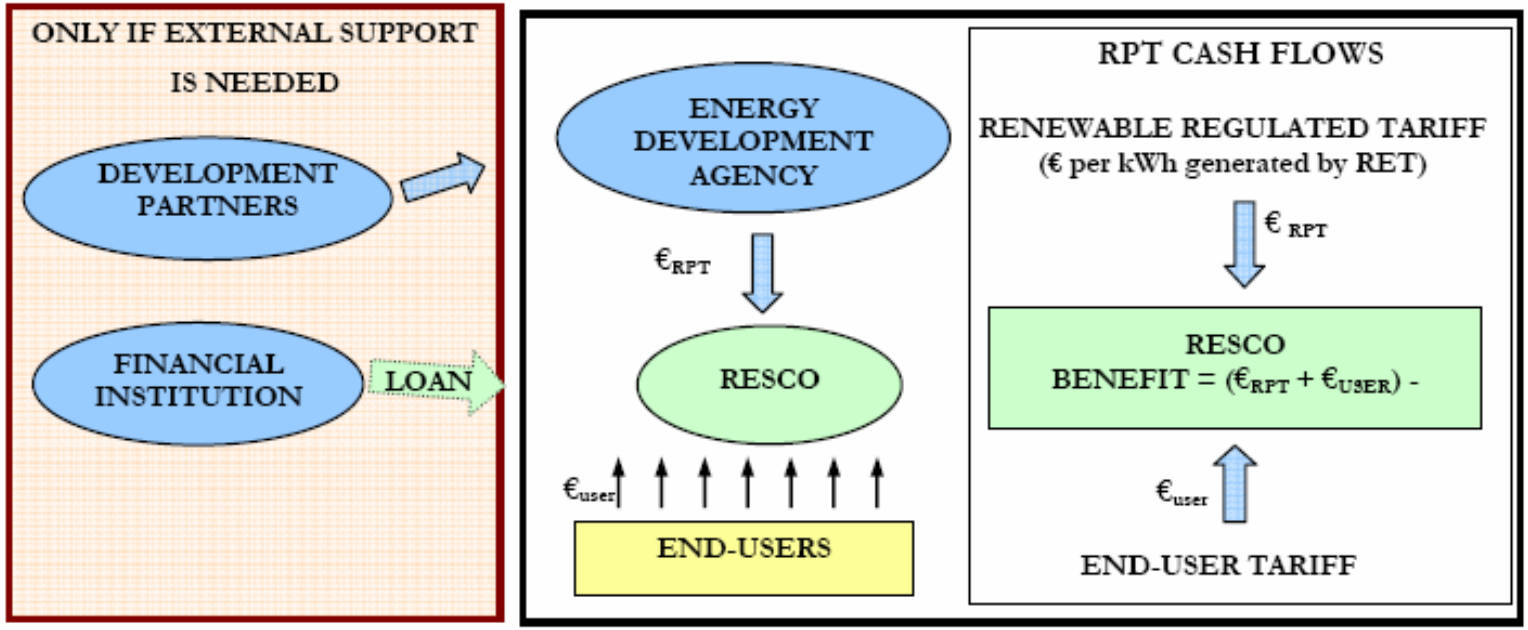
Different local renewable energy sources are suitable to form a hybrid grid



Source: ARE & SMA 2009

FiT for mini grids

Figure VI. RPT financial flow scheme for a village scale mini-grid under a regulated energy-service concession.

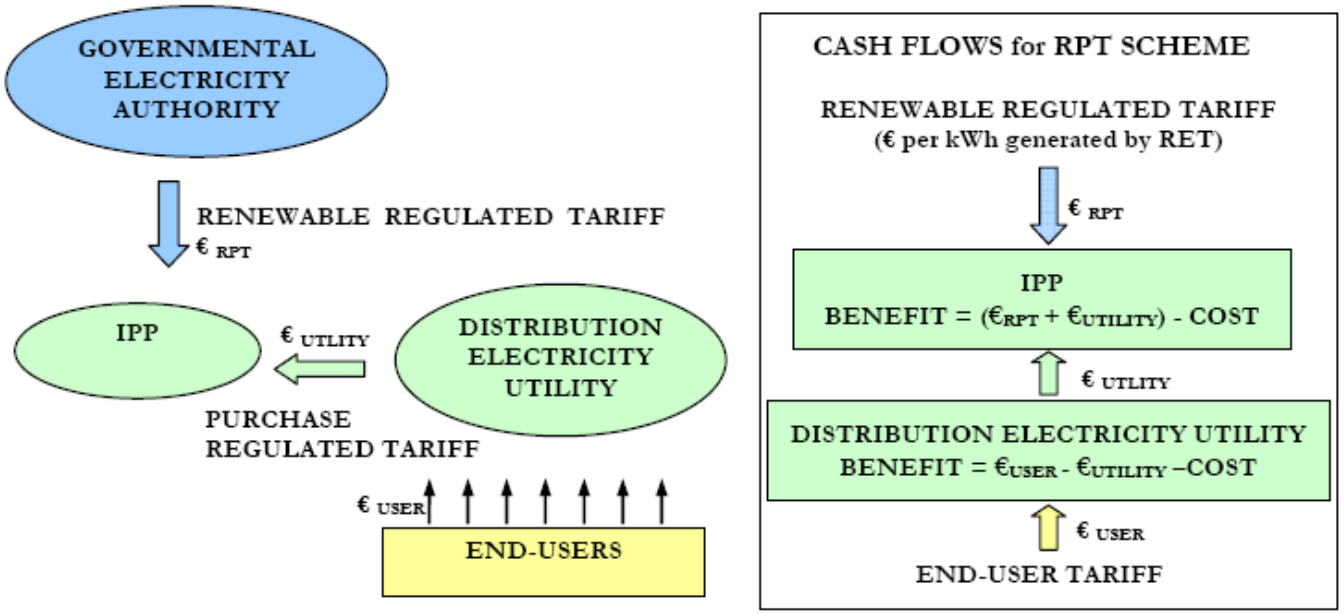


Money flows are represented by the arrows

Source: M. Moner (JRC), P. Llamas (ARE), X. Vallve (TTA).

FiT for mini grids

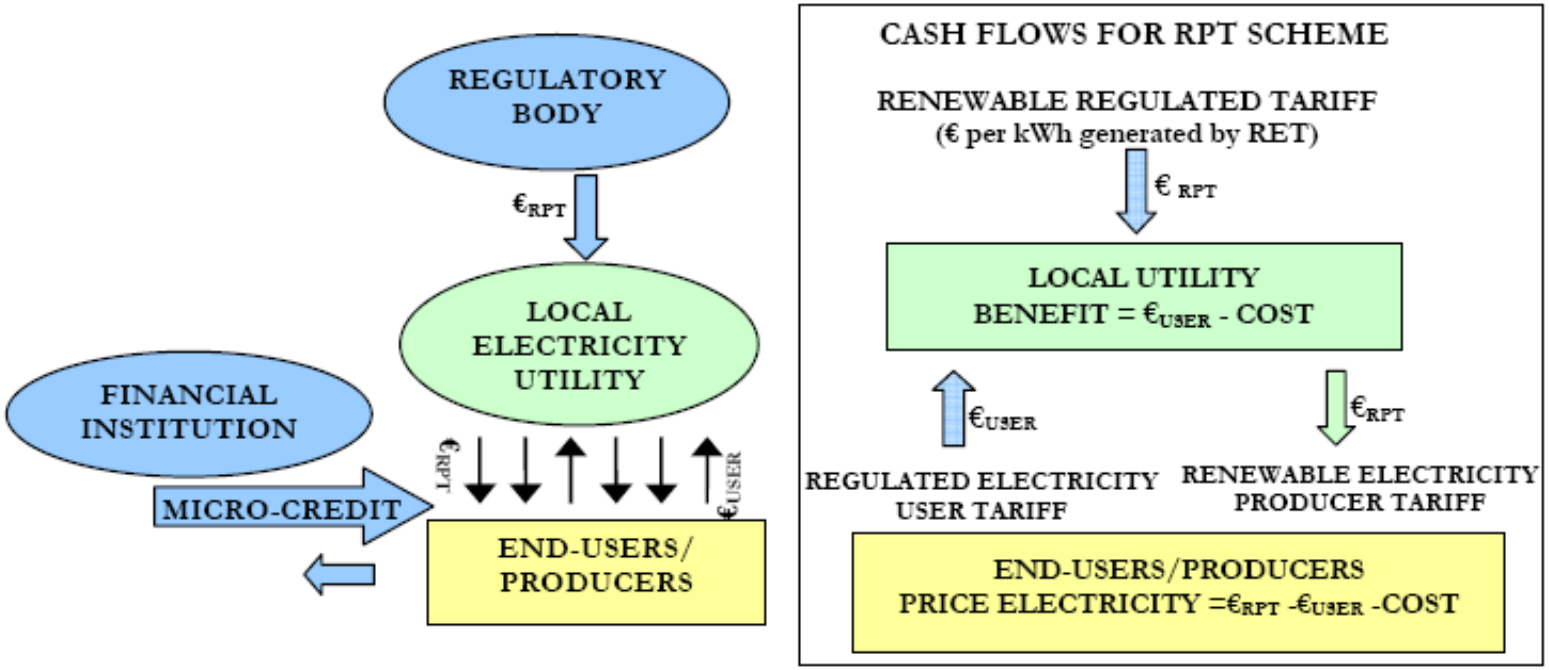
Figure VIII. Renewable regulated tariff scheme for independent power producer. The local Utility operates the RPT allocations. The IPP sells renewable electricity to the distribution Utility (at the established renewable regulated tariff), then the Utility sells the electricity to the end-users at the nationally regulated consumer tariffs. The IPP is supposed to collect the regulated RPT. Money flows are represented by the arrows.



Source: M. Moner (JRC), A. Shanker, D. Rambaud-Méasson (IED).

FiT for mini grids

Figure IX. RPT tariff for independent renewable producers/users.



Source: M. Moner (JRC), P. Llamas (ARE).

Thank you for your attention!

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