National Renewable Energy Laboratory
Innovation for Our Energy Future

Renewable Energy Feed-in Tariffs: Lessons Learned from the U.S. and Abroad

U.S. Department of Energy (DOE) Technical Assistance Project (TAP) Webinar

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Presentation Overview

- Feed-in Tariff (FIT) Policy Overview
- FIT Policy Implementation in the U.S.
- Policy Design Comparison with Europe
- FIT Policy Clarifications (differences with PURPA)
- Policy Interactions (RES, climate legislation)
- Policy Design and Implementation Challenges

Feed-In-Tariff Definition

Feed-in Tariff* (FIT):** A renewable energy policy that typically offers a **guarantee of**:

1. **Payments** to project owners for total kWh of renewable electricity produced;
2. **Access to the grid**; and
3. Stable, **long-term contracts** (15-20 years)

* A tariff is an electricity rate paid for generation.

** Also called fixed-price policies, minimum price policies, standard offer contracts, feed laws, renewable energy payments, renewable energy dividends and advanced renewable tariffs.

Fundamental FIT Policy Design Options

(1) Price method: Estimated cost + targeted return (e.g. VT, HI)
Avoided cost (e.g. CA)

(2) Payment structure: Fixed-payment
Premium-payment
Constant (over spot market)
Sliding

(3) Differentiation: technology, project size, location of project, and sometimes resource quality

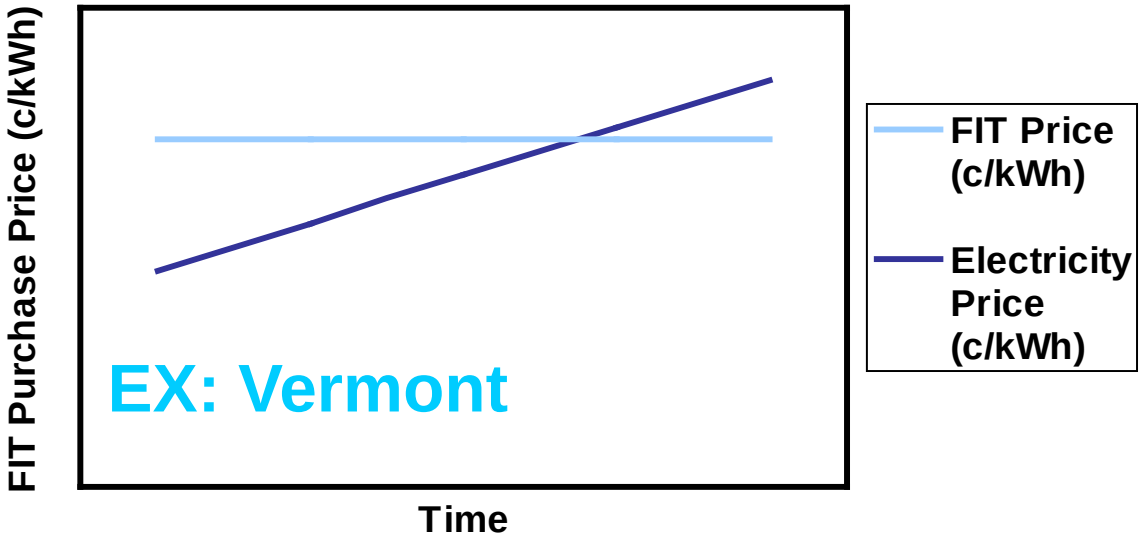
(4) Bonus payments: target "smartgrid" principles – peak periods; optimal use of transmission system; specific technologies (*e.g. advanced grid integration, emerging tech*); certain ownership structures (*e.g. community owned*); deployment in locations with high loads (*e.g. urban centers*), etc.

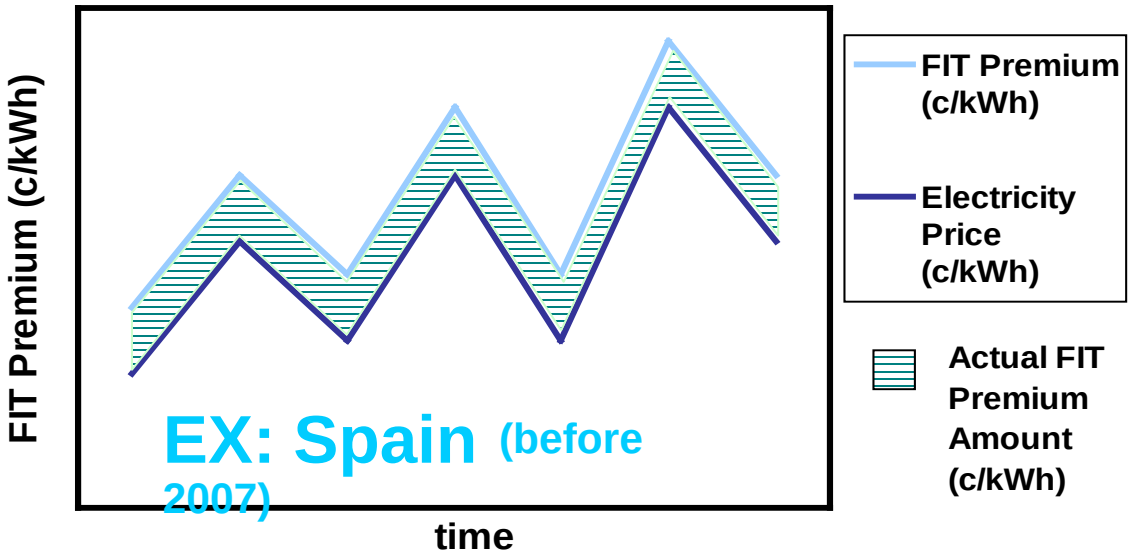
FIT Payment Choice - 1

(1) Fixed Price FIT Payment (can include escalation)

Most countries use fixed-price FIT payments

(2a) Premium FIT Payment (above spot market)

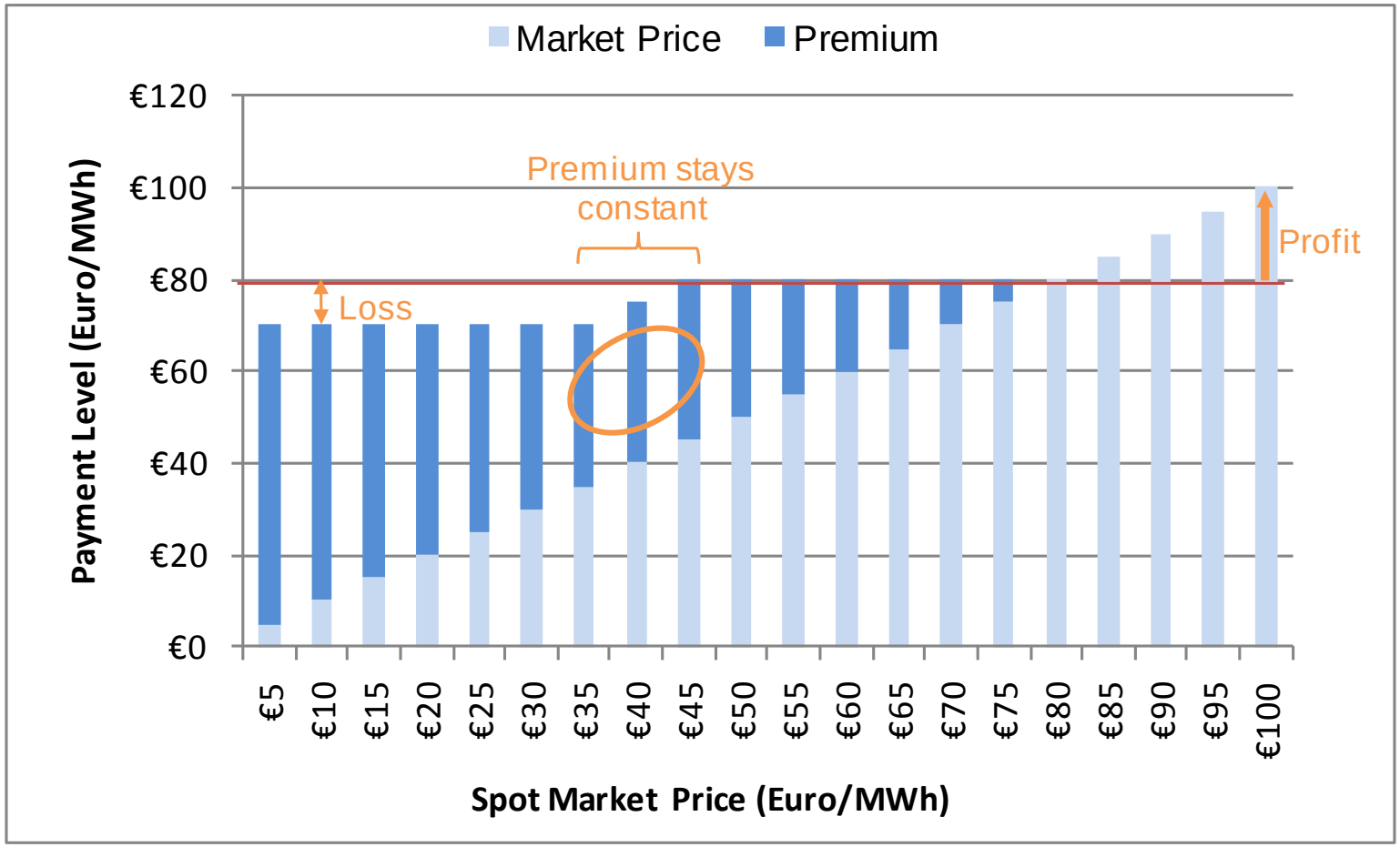




FIT Payment Choice - 2

(2b) Premium FIT Payment *with Caps and Floors*

EX: Spain (2007 and beyond)



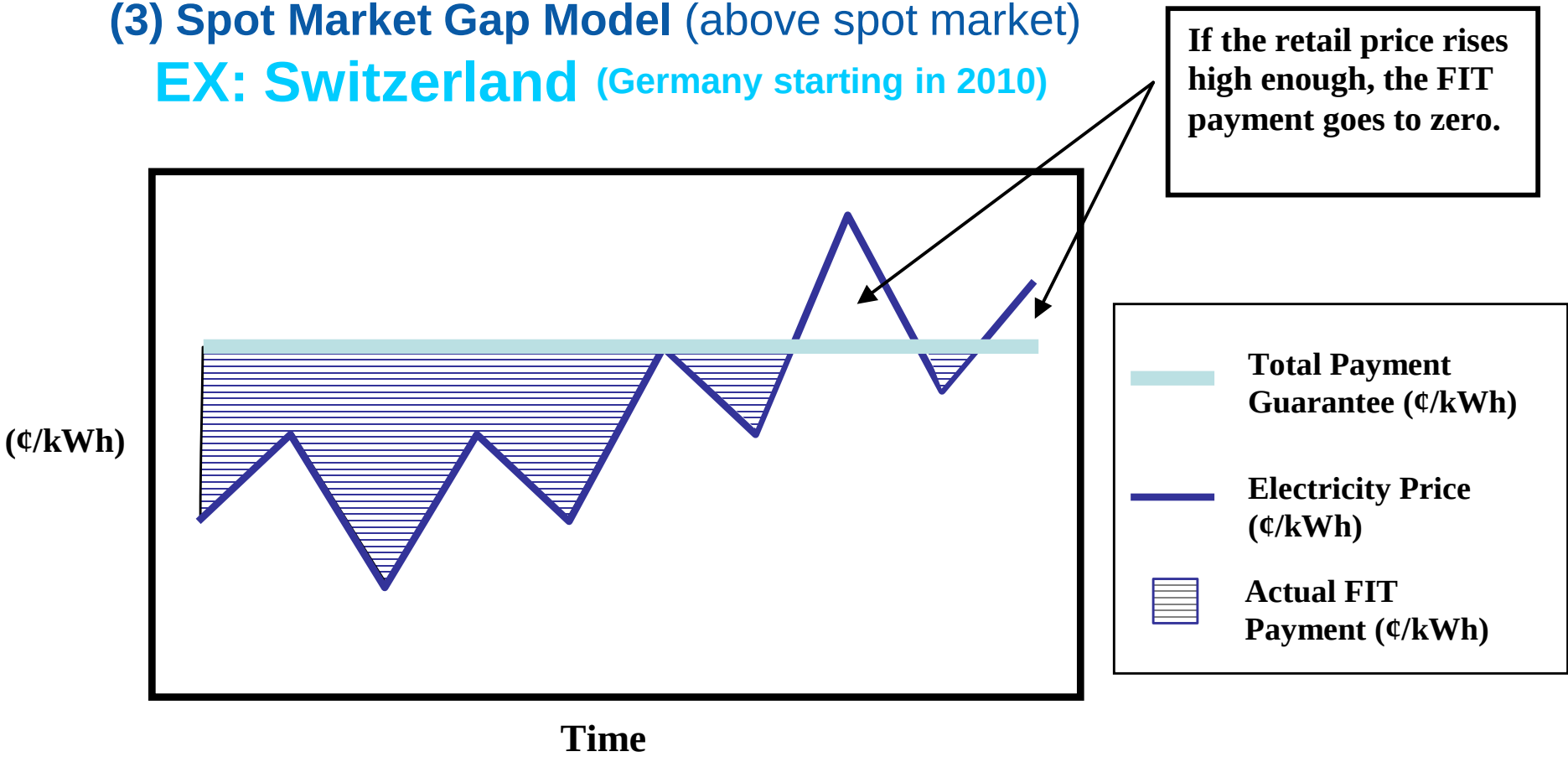
Source: Ragwitz, M. (2009).

FIT Payment Choice - 3

Refinements to FIT payment methodologies

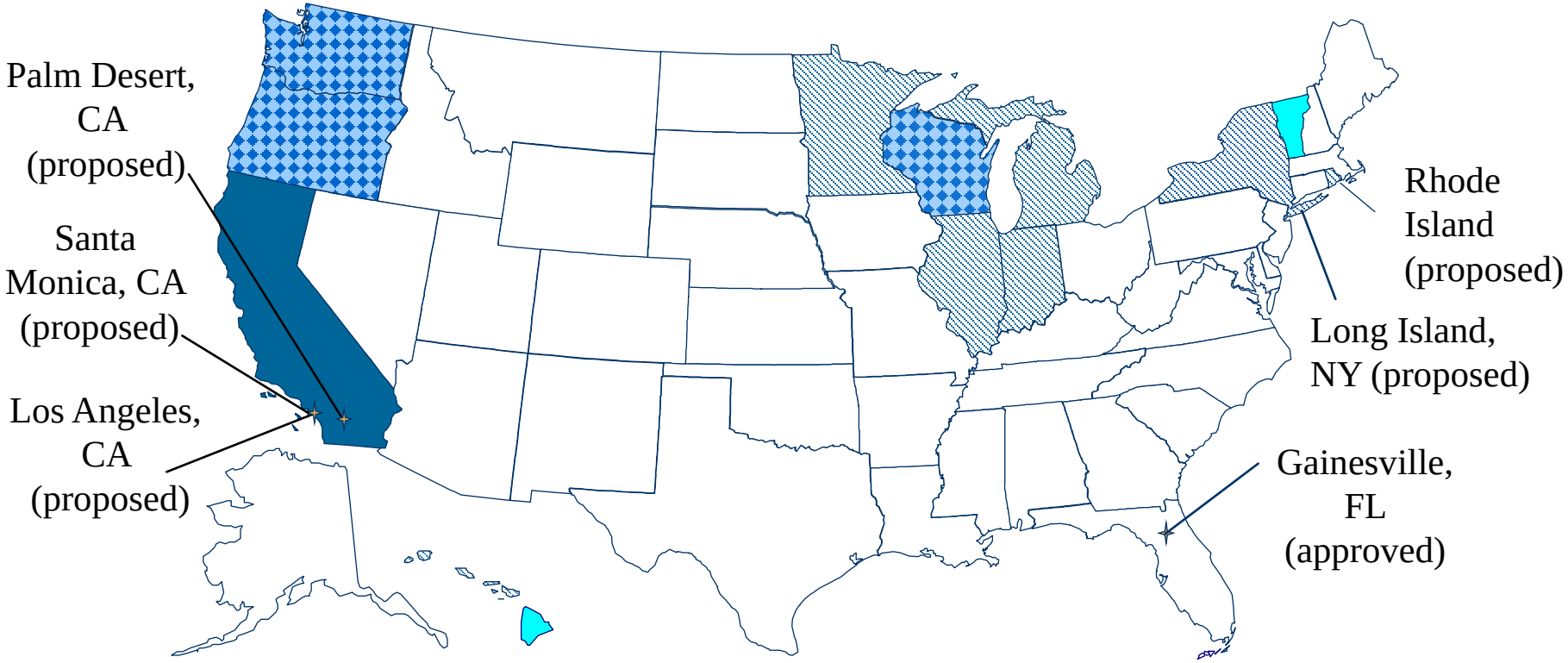
(3) Spot Market Gap Model (above spot market)

EX: Switzerland **(Germany starting in 2010)**



FIT Policy: Application in the U.S.

Note: Gainesville Regional Utilities, has approved the first U.S. cost-based FIT for solar PV. In May 2009, Vermont enacted the first statewide FIT policy based on the RE project cost.



- Two states (+1 muni) enacted FIT legislation based on RE project cost (VT, HI)
- One state enacted FIT legislation based on avoided cost (CA)
- Three states enacted utility-based FITs (OR, WA, WI)
- Seven states (incl. 4 munis) proposed FIT legislation on RE project cost

Source: NREL - adapted from Gipe www.wind-works.org, Sept 2009

California FIT – AB 32

Sectors: Commercial, Industrial, Residential

Length: 10-, 15- or 20-year contracts

Payment: Based on avoided costs

- CPUC market price referent (MPR)
- Adjusted by time-of-use factors
- Higher solar energy rates (8 a.m. – 6 p.m.)

Caps: State-wide Program: 750 MW

Project size: 3 MW

Technologies: Solar Thermal Electric, Photovoltaics, Landfill Gas, Wind, Biomass, Geothermal Electric, Municipal Solid Waste, Anaerobic Digestion, Small Hydroelectric, Tidal Energy, Wave Energy, Ocean Thermal, Biodiesel, Fuel Cells (Renewable Fuels)

Vermont Energy Act (Act 45 – HB 446)

Sectors: Commercial, Industrial, Agricultural, Owners of Qualified SPEED Resources

Length: 25 year contracts (solar)

15-20 years (other technologies)

Payment: Based on project cost + profit

- Landfill methane: $0.12/kWh
- Agricultural methane: $0.16/kWh
- Wind (<15 kW): $0.20/kWh
- Wind (>15 kW), Hydro or Biomass: $0.125/kWh
- Solar: $0.30/kWh

Caps: State-wide Program: 50 MW

Project size: 2.2 MW

Technologies: Photovoltaics, Landfill Gas, Wind, Biomass, Hydroelectric, Municipal Solid Waste, Anaerobic Digestion, Small Hydroelectric

FIT policy: Flexible Design

	Germany	Spain	The Netherlands
Payment level basis	RE project cost (declines over time)	'08: premium + spot '09: RE project cost	RE project cost (declines over time)
Payment level structure (for a contract)	Fixed payment level, 20 years, no inflation adj.	'09: Fixed or premium w/cap and floor (PV: fixed only), 15-25 years, w/inflation adj.	Spot market gap
Differentiation	Tech., project size, resource quality, and vintage	Tech., and project size	Tech., project size, and resource quality
Caps a/project size	a/ biomass: 20 MW a/ (none for wind or solar)	a/ '08 PV: 50 MW a/ '09 PV: 10 MW	a/ PV: 3.5 kW
b/program	b/none	b/ '08 PV: 5 year target (National Energy Plan) b/ '09 solar: 400 MW b/ '10 wind: 20,155 MW	b/ 4-year budgets: - Wind: ~2,000 MW - Offshore: ~400 MW - Biomass: ~250MW - Biogas: ~15 MW - PV: ~70-90MW
Payment level adjustments	Analyzed every 4 years with annual increments	Analyzed annually, re-set (and retroactive)	Subject to government review at any time

Sources: EEG 2008, RD 661/2007, RD 1578/2008, and van Erck 2008

EU Thoughts on FIT Policy Success

European analysts attribute RE sector success to the following FIT policy elements:

1. are methodologically based on RE project costs (+ return)
2. are in place over a long period of time to provide policy stability and reduce uncertainty
3. Payments are differentiated by technology type, project size, and resource quality.
4. involve long-term contracts (15-25 years)
5. include built-in decreased payments to drive innovation and cost-reduction over time
6. are generally available to all end-users & project investors
7. minimize the use of program and project caps (target their use for high-cost or emerging technologies)

Key differences: U.S. & EU

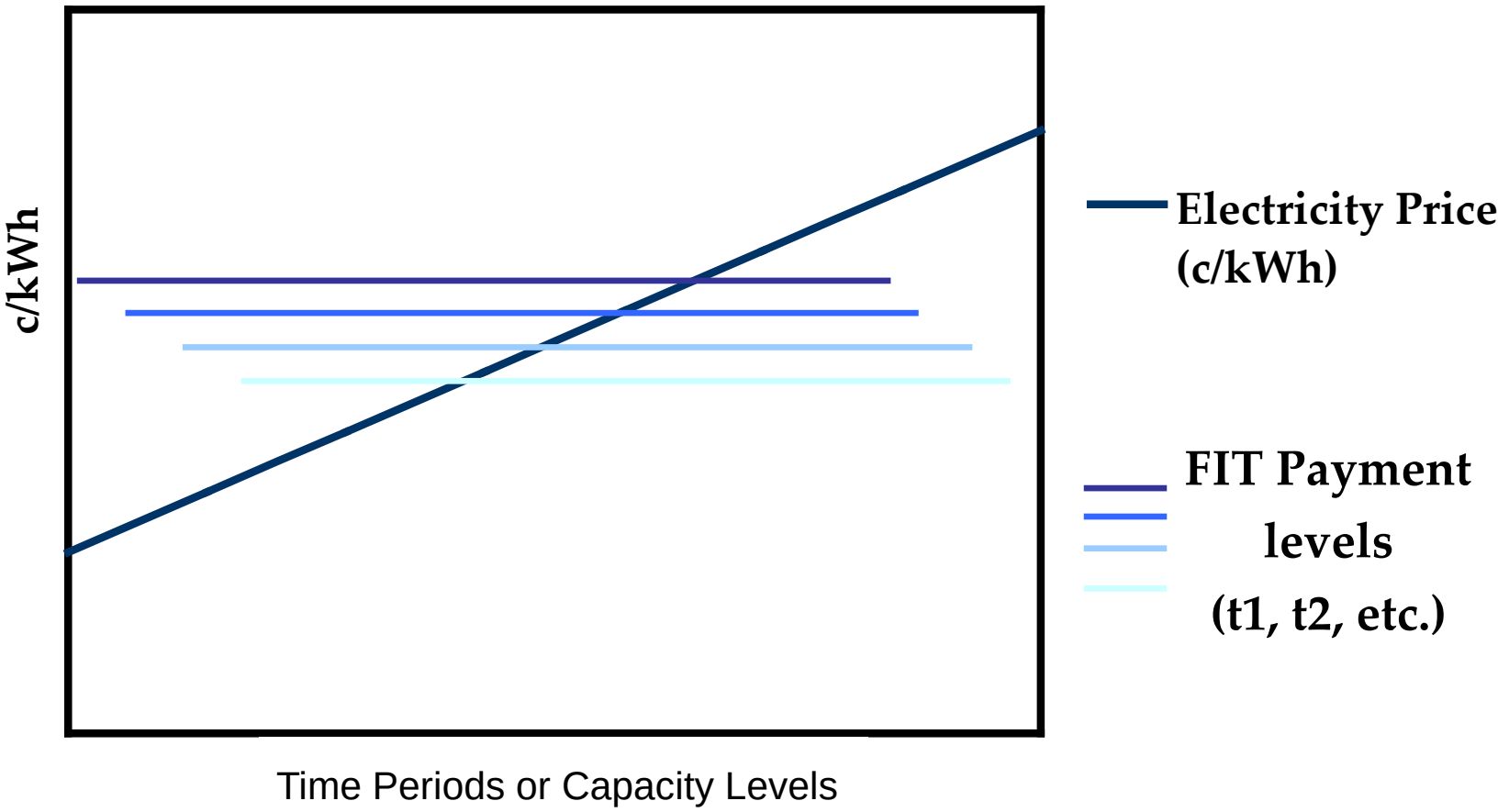
1. **Methodology used to set payment level**
   - U.S.: Utility avoided generation costs, typically
   - EU: Estimated RE project costs (plus a reasonable profit)

2. **Ability to encourage diversity**
   - U.S.: Often target one tech., at DG level
   - EU: Differentiate payments based on technology, size of project, quality of resource, number of install., and other locational factors

3. **Investor certainty provided**
   - EU: guaranteed 15-25 year contracts to meet long-term goals
   - U.S.: often use shorter contracts and program/project caps

4. **Breadth of eligible participants**
   - U.S.: Com. & Ind. customers (sometimes residential)
   - EU: above PLUS fed/state/local govt., NGOs and utilities

Tariff Degression



FIT Policy Clarifications

- **FITs are not a "foreign" policy**
  - Genesis: California "standard offer contract" (PURPA)
  - U.S. utilities get **cost-recovery + profit** for conventional generation
- **FITs are not the same as PURPA**
- **FIT policies can be used to meet renewable electricity (and climate change) goals**
- **FITs can provide investor certainty**

PURPA: a FIT Policy Precursor

FIT payments are distinctly different from PURPA

- → PURPA payments were anchored on erroneous projections (e.g. oil)
- → In reality, actual electricity prices diverged greatly from forecasts (NG-fired power on the margin; lower fuel prices);
  - → PURPA payments remained high and continued to grow
- → In contrast, FITs are not usually tied to fossil fuel/electricity prices (mostly tied to est. project costs), and payments are levelized (perhaps small, fixed escalator of 2-3%).

CA SOC No. 4: contracts based on utility projections of long-run fossil fuel prices

% of retail electricity price FIT policies

Avoided cost-based FIT policies

Undifferentiated FIT policies

Modern FITs, fully differentiated, most often based on RE project cost estimates

FITs and RPS: complimentary policies

- **Utilities either own power generation, or they purchase power through competitive solicitations (i.e. request for proposal/RFP)**
- **FITs replace/compliment RFPs, NOT RPS policies (e.g. EU countries use FITs to achieve goals)**
- **Options for implementation**
  1. FITs can be designed to target distributed generation only
     - RFPs left to target utility-scale systems
  2. FITs can be used for utility-scale projects
     - Used ***between*** competitive solicitations
     - Can ***replace*** utility RFPs.

FITs in the Financial Crisis

- U.S. tax equity market consolidation
- FITs facilitate project financing through guaranteed, long-term contract for system output
  - Help attract capital to RE market
  - Ratepayer backing attractive to debt lenders
- FIT policy can stimulate new industries, create jobs, if designed well
  - Long-term policy commitment
  - Differentiation for diversity
  - Large targets/caps (e.g. Ontario)
- FITs can provide the opportunity for low-risk, moderate returns on local energy investments

FIT Policy Challenges

Up-front capital need: Does not directly offset the need for substantial capital to pay for up-front project costs

- But L-T contracts ⬆ investor confidence

Setting FIT payment level is challenging: if set too low, little new RE development; if too high, surplus profits to developers

Policy design challenge: Tracking technological improvement and cost reduction accurately over time

Complexity: Usually many levels of differentiation

Cost: supporting emerging and higher-cost technologies can lead to upward pressure on electricity costs (and rates)

- Can be designed to limit support for such technologies

Policy crutch: concern that RE industries could develop a reliance on FITs for project deployment; no incentive for innovation

- Payment can ramp down over time, to encourage innovation

FIT Policies: Key Takeaways

1. Europe credits rapid and stable expansion of diverse RE projects on key FIT policy elements:
   - Long-term policy stability (to attract investors)
   - Long-term contracts (and thus lower c/kWh payments)
   - Target estimated RE project costs across technologies, project sizes, and vintage through differentiation
   - Most end-users able to participate
2. FIT policies are for supply procurement and they can be used to compliment RES and climate policy goals.
3. If designed well, can limit ratepayer costs and also provide investor certainty.
4. Long-term targets can drive new RE investment.

Overview of NREL FIT Tasks

Analysts	Tasks
Exeter Associates, Inc. Sustainable Energy Advantage Meister Consultants Group	1. FIT Model and FIT Rate Setting 2. Interconnection Policy Best Practices
National Regulatory Research Institute (Scott Hempling) Law Offices of Carolyn Elefant	3. FIT Legal Analysis
Karlynn Cory and Claire Kreycik, NREL	4. Technical and policy assistance to specific states

NREL Reports

"***Feed-in Tariff Policy: Design, Implementation, and RPS Policy Interactions***" **NREL, March 2009**

http://www.nrel.gov/docs/fy09osti/45549.pdf

"***State Clean Energy Policies Analysis (SCEPA) Project: An Analysis of Renewable Energy Feed-in Tariffs in the United States***" **NREL, May 2009 (revised June 2009)**

http://www.nrel.gov/docs/fy09osti/45551.pdf

COMING SOON

"***Feed-in Tariff Policy Design and Implementation: Best Practices Guide***" **NREL, 2009**

http://www.nrel.gov/docs/fy09osti/44849.pdf

Thank you for your attention!

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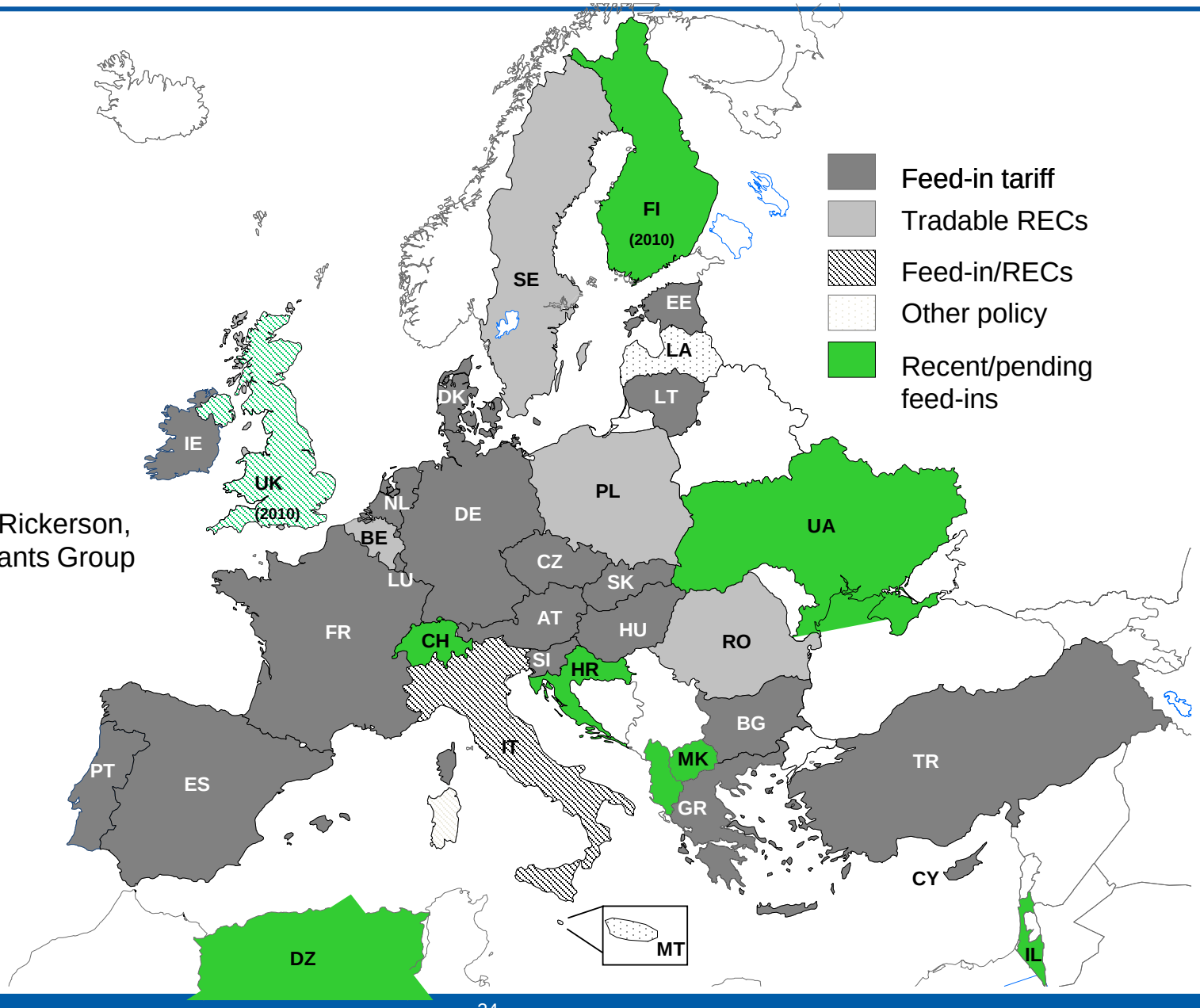
FIT Policy: Application in Europe



Source: Wilson Rickerson, Meister Consultants Group