Implementing Feed-In Tariff in the United States: Lessons from Willingness-to-Pay Studies and Customer Research

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Thesis Presentation

Question

- Is implementation of feed-in tariff in the U.S politically feasible?

Feed-in Tariff:

A mechanism which encourages development of renewable electricity through pre-determining the price at which it is bought

Agenda

- Growing attention paid to renewable energy
- Renewable electricity developments
  - Why are we behind?
- European successes
- Strengths of feed-in tariff
- Barriers to implementing feed-in tariff in the U.S
- Analysis
  - Willingness-to-Pay studies
  - Customer research
- Discussion

Growing attention paid to renewable energy

- Environmental Impacts
  - Carbon emissions
  - Air pollution
- Energy Independence
  - Volatile fossil fuel prices
  - Uncertainty in future supplies
- Job Creation

Renewable electricity developments

- Electricity sector is a major consumer of fossil based fuels
  - Approximately 40% of carbon emissions in the U.S
- European countries
  - Denmark – 20% (wind)
  - Spain – 16.2%

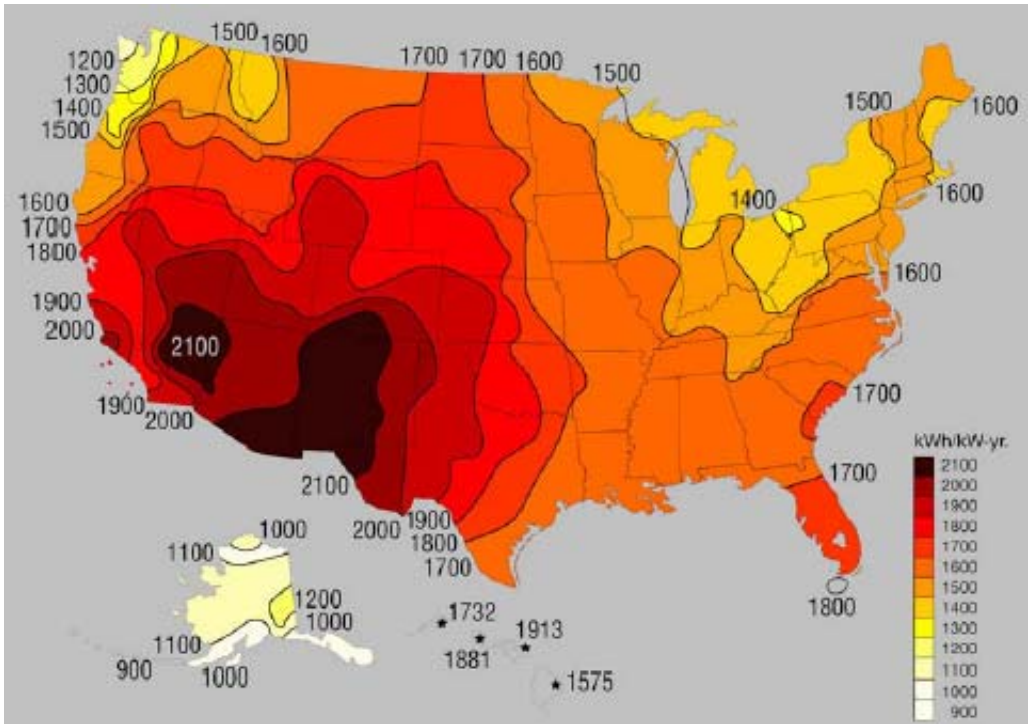
U.S – 2%

Why are we behind?

- **NOT** due to lack of resources

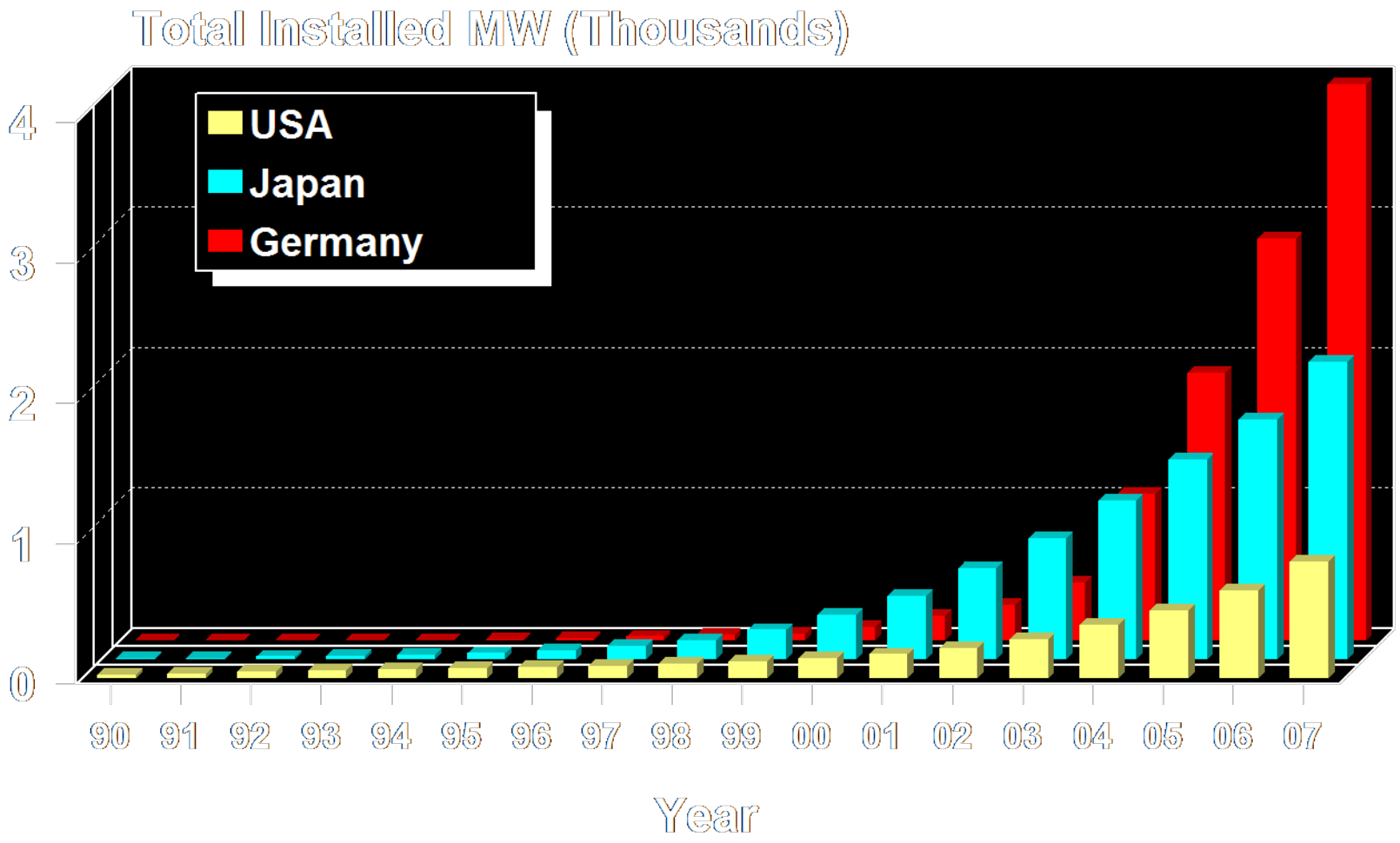
U.S vs. Germany: Solar

- Comparison of solar intensity



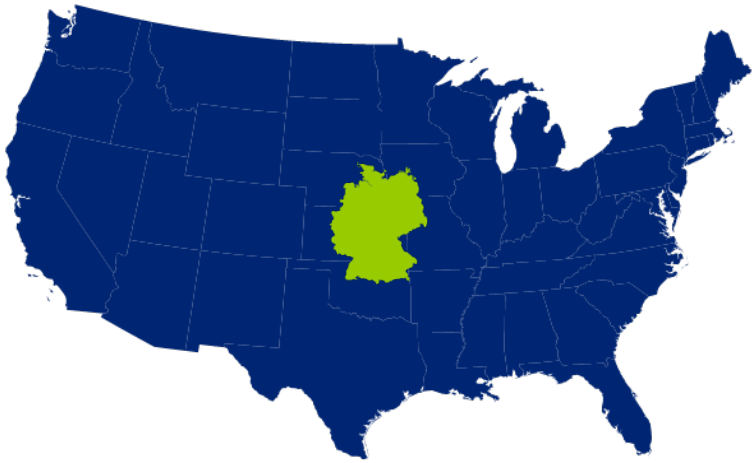
Map credit: Jerry Karnas, Environmental Defense Fund

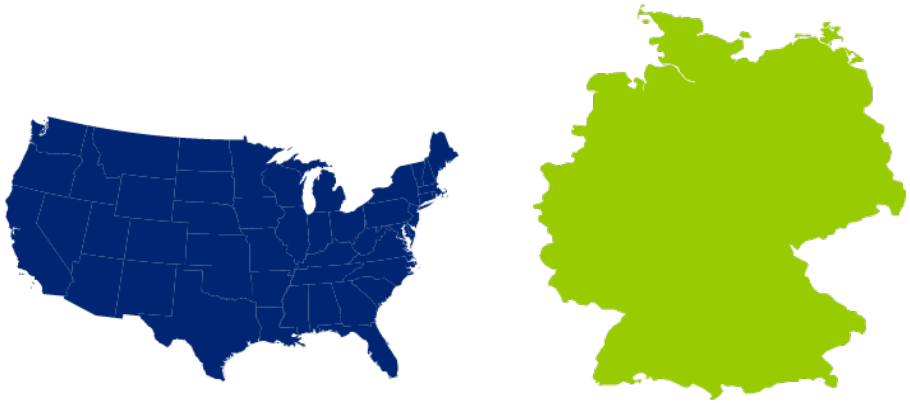
European Successes: Solar



Adopted from:Paul Gipe, Wind-works.org

U.S vs. Germany: Wind





Land area

Continental U.S	Germany
8,154,157 km²	357,030 km²

23 : 1

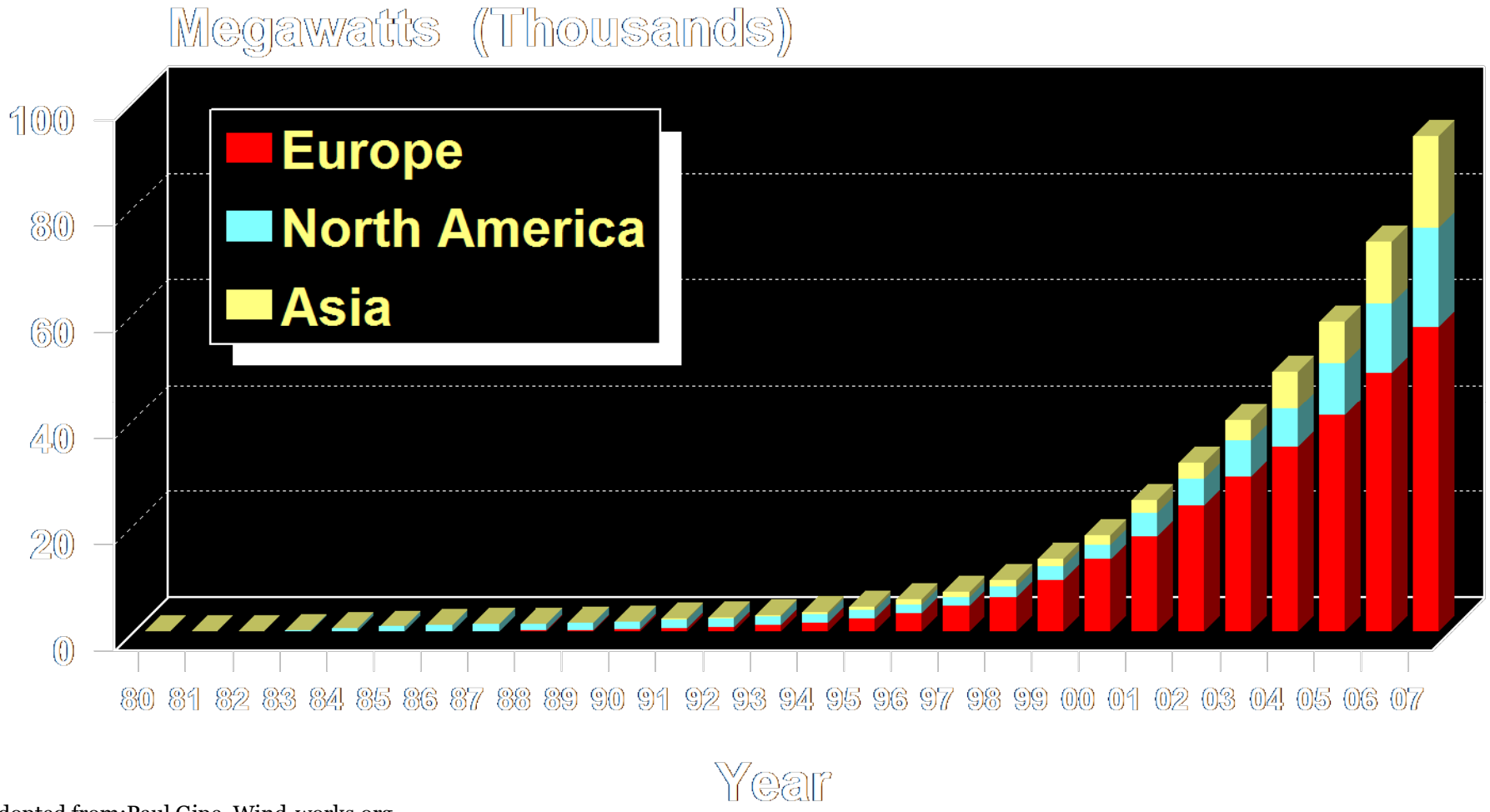
Wind energy installed capacity

Continental U.S	Germany
16,818 MW	22,247 MW

1 : 1.3

Map credit: Ryan Perroy, University of California, Santa Barbara

European Successes: Wind



Adopted from:Paul Gipe, Wind-works.org

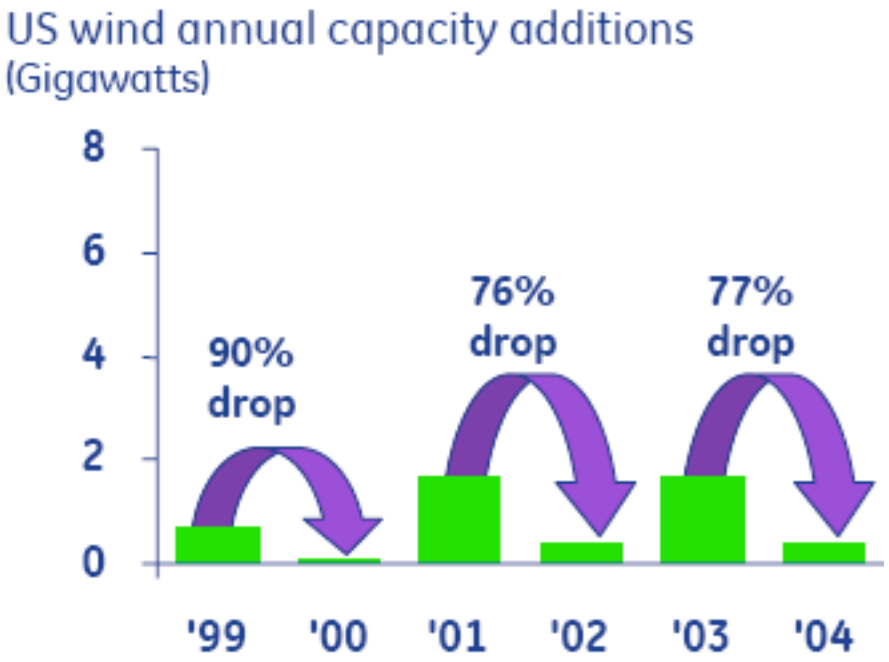
Importance of support schemes

- Cost-disadvantages of RE production
  - Environmental costs of fossil fuel energy is not internalized
  - Existing subsidies for fossil fuel
  - Random nature of sources of renewables

Some form of support scheme is **necessary** for RE development

Why are we behind?

- Lack of policy support
  - Federal tax credits
    - Unpredictable renewals discouraged investments
  - State Renewable Portfolio Standard
    - Adopted by only about half of the states
    - Various levels of progress by each state



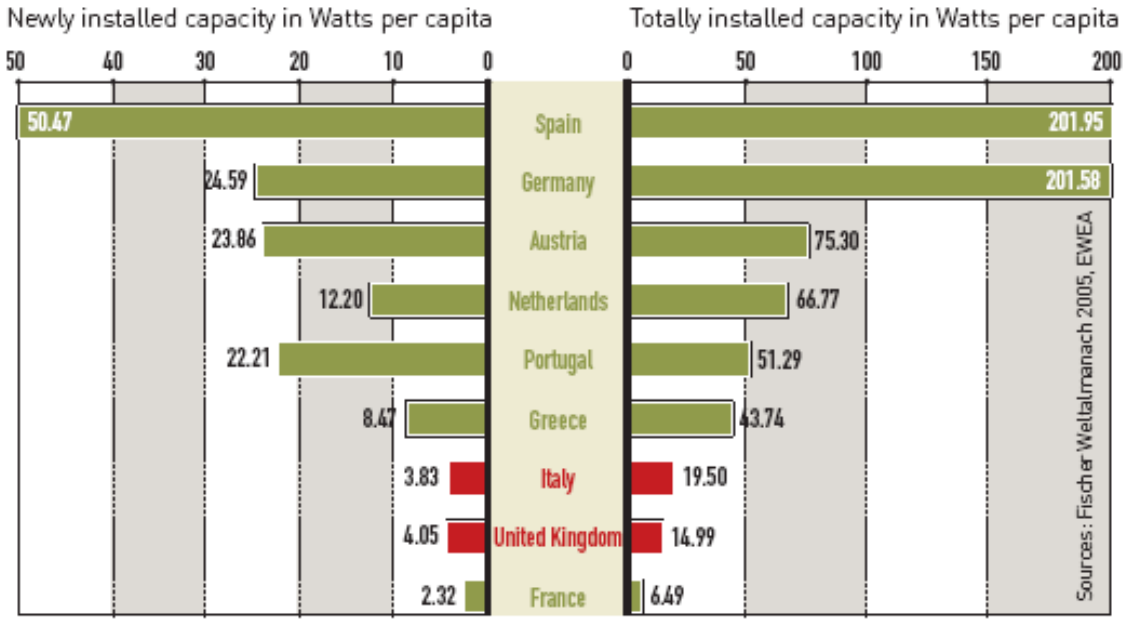
Map credit: GE Financial Services, 2007

European support schemes

- Two main types of schemes
  - Price-based (FIT)
    - Encourages RE development through setting the price at which RE is bought
    - 17 European countries
  - Quota-based
    - Government sets a target level of RE production, and encourages RE development through penalties, tradable permits
    - UK , Sweden, Italy

Price vs. Quantity-based: Capacity

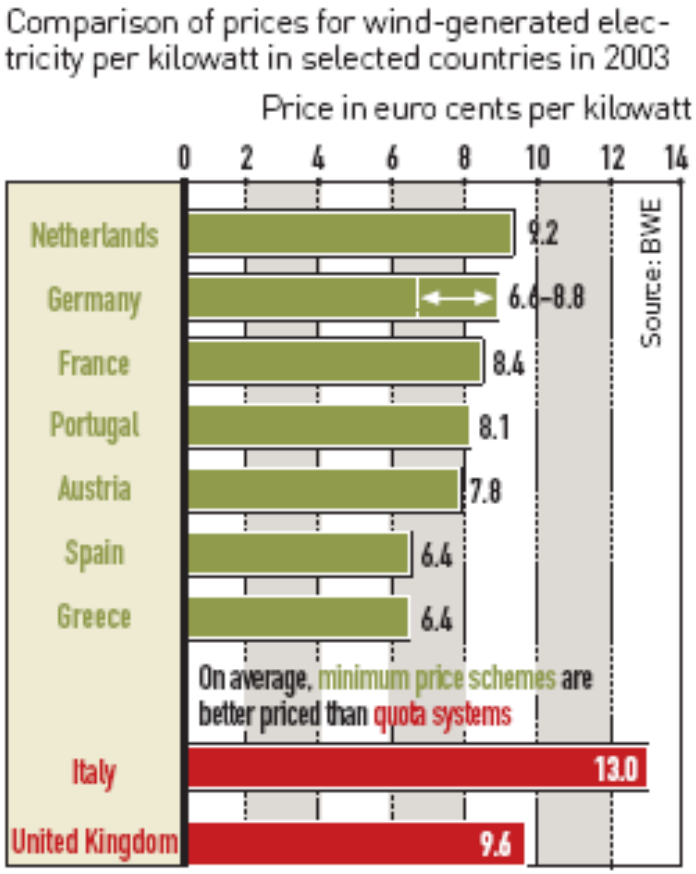
- Most capacity added in countries with feed-in tariff
  - Spain and Germany with strong FIT scheme



Adopted from: “Fixed prices work better”, Claudia Grotz and Dorte Fouquet

Price vs. Quota-based: Cost

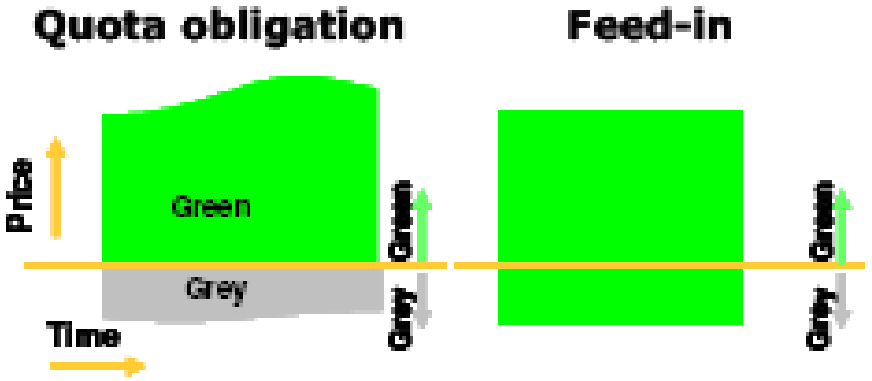
- Price-based schemes are generally as cost-effective compared to quota-based schemes



Adopted from: “Fixed prices work better”, Claudia Grotz and Dorte Fouquet

Strengths of Feed-in tariff

- Easier to finance projects
  - RE project investments are **less risky** due to predictable revenue stream
  - Developers can obtain financing with lower cost of capital – less cost
- Development of costlier renewables
  - Through setting different levels of electricity prices
  - Difficult in a market based quota system
  - Only lowest cost option adopted



Adopted from: "Policy instrument design to reduce financing costs in renewable energy technology projects", David de Jager and Max Rathmann

European successes

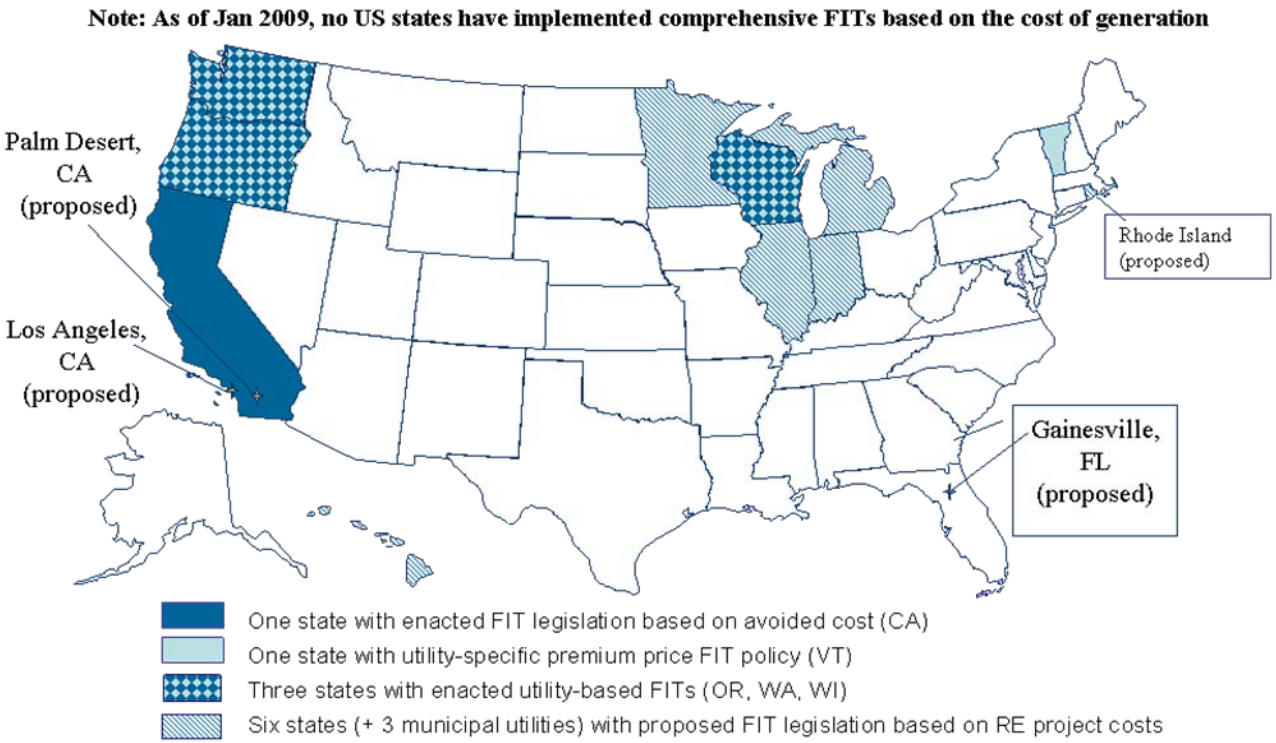
- Much more to the debate for the best type of support scheme
  - Influences of other domestic support measures
  - Better designed FIT vs. Badly designed quota
- FIT has shortcomings
  - Difficulty in setting the right price for electricity

- Amounting evidence that FIT can be effective
  - UK, Japan recently began considering its own versions

FIT should be considered for implementation in the U.S

Implementing FIT in the U.S

- Limited penetration
  - Some states have implemented / considered limited version of FIT
  - Federal level FIT proposed by rep. Inslee



Map credit: NREL adopted from Gipe, 2009

Points of contention for FIT in the U.S

- Complex utility structure
  - Utilities with different ownership structures
  - Need a comprehensive payment system to redistribute the burden of renewables
- Political
  - Non-market based scheme
    - higher levels of payments to certain types of renewables
  - Resulting increase in electricity rate
    - negative experiences with legislation in the 70's which resulted in windfall profits

Question

- Is implementation of feed-in tariff in the U.S politically feasible?
  - How much are consumers willing to pay more for renewable electricity?
  - Would consumers accept paying more to support costlier types of renewables?
  - How can we foster understanding for FIT in the U.S to gain support?

Methodology

- Evaluation of various customer research/ willingness to pay studies in the U.S regarding renewable electricity

Willingness to Pay: A measure of the value an individual would place on certain item or service. Can be evaluated hypothetically

- In all of the studies, surveys were used to gauge WTP of U.S consumers for RE

Methodology

- Values of WTP
  - Is it high enough to implement FIT-type scheme in the U.S? (Germany's FIT is said to cost about several euros/month)
- Variations of WTP
  - Are values different among sources of renewables?
- Any factors that increase/decrease values of WTP
  - How can we foster support for FIT in the U.S?

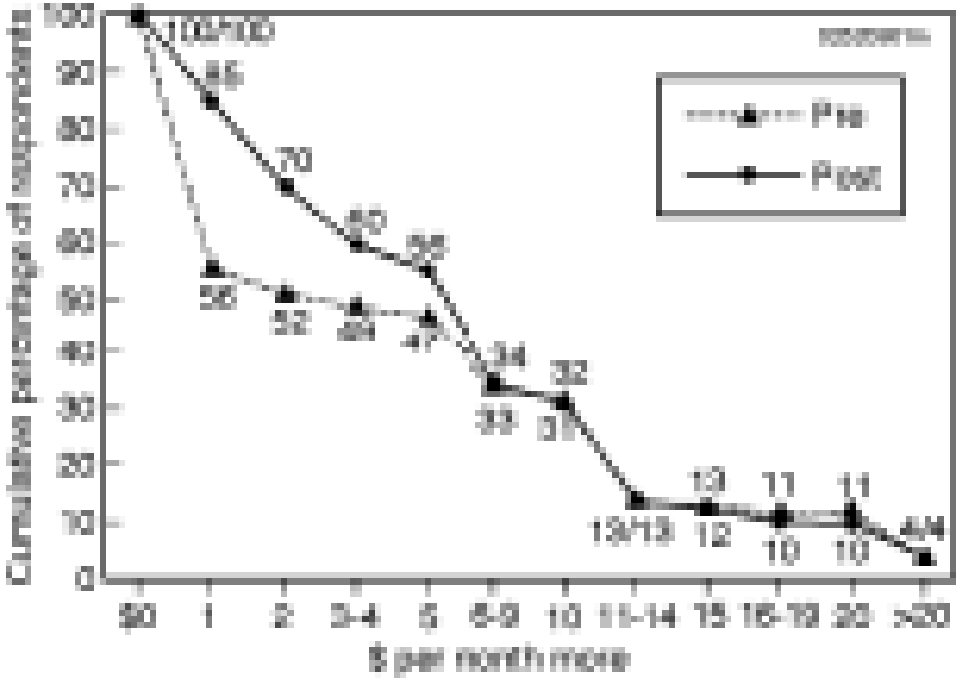
Farhar, 1999

- Compiled 14 customer surveys from 12 utilities in Southwestern areas

- Findings
  - 95% of respondents stated they would pay some premium for RE
  - Mean range of WTP: $5 – 10
  - Solar and wind are the most preferred options of renewables with highest WTP values
  - 80% of respondents indicated desire to share cost of renewables with others

Farhar, contd.

- Education vs. WTP
  - Higher WTP among respondents after participating in an informative discussion session



Adopted from: “Willingness to pay for power from renewable sources”, Barbara Farhar

Roe et al, 2001

- Approximately 1000 survey participants from cities across the U.S

- Findings
  - Higher level of education and affiliation with environmental group – higher WTP
  - Comparison of RE vs. nuclear power
    - Higher WTP for RE in all areas but Southeast
    - Regional variations

Roe, contd.

	For a 1% increase in renewable fuel[a] and a 1% decrease in emissions	For a 1% increase in nuclear fuel[b] and a 1% decrease in emissions
Southeast	**22.14** [2.69, 64.22]	**27.66** [7.99, 73.27]
Midwest	8.70 [− 16.74, 35.47]	− 3.33 [− 29.39, 15.82]
Northeast	**27.10** [2.63, 56.93]	8.42 [− 14.16, 27.69]
Southwest	19.85 [− 6.21, 48.17]	5.32 [− 18.58, 23.68]
Northwest	15.77 [− 10.71, 47.77]	11.84 [− 13.08, 36.26]

Adopted from: “US consumers willingness to pay for green electricity”, Brian Roe

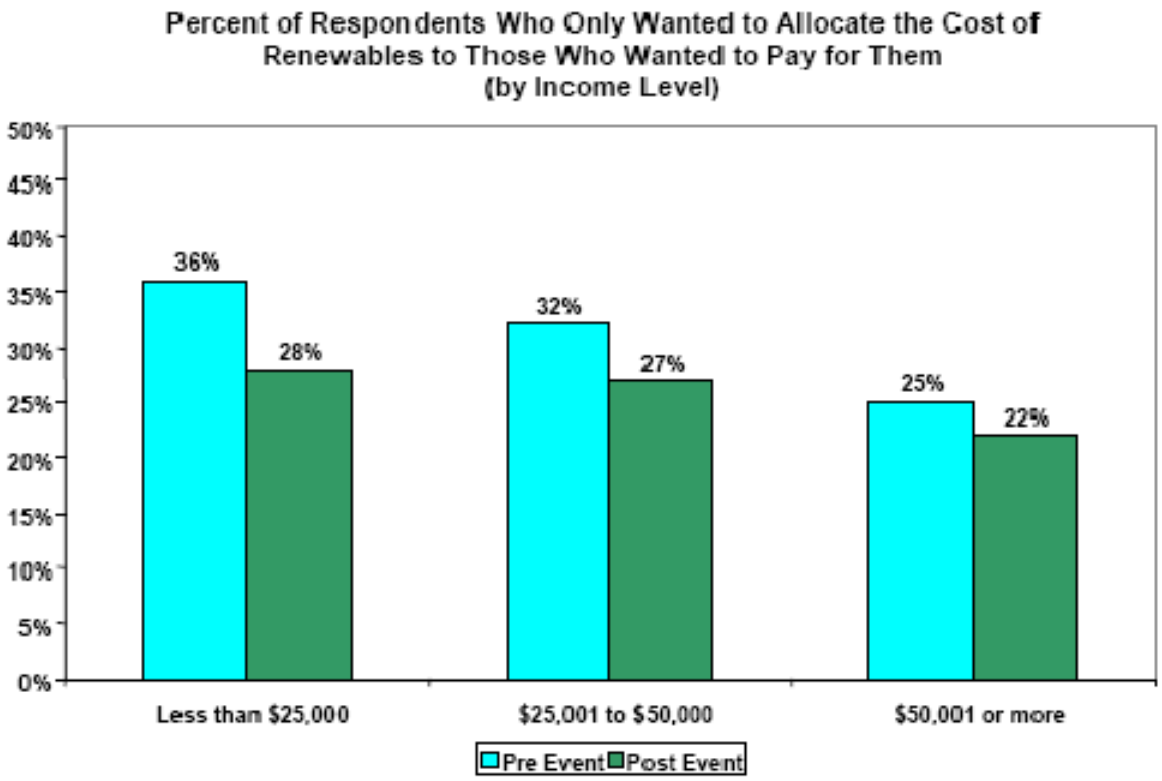
Lehr et al, 2003

- Customer survey conducted by Texas utilities
- Focused on impacts of education: Employed a methodology similar to Farhar's

- Findings
  - Mean WTP: $1.50 - 6.50
  - 60% of customers preferred energy options with higher upfront cost and lower running cost

Lehr, contd.

- Only 30% indicated preference for limited allocation of cost of renewables
  - Increased with income level + after discussion



Adopted from: "Listening to Customers: How Deliberative Polling Helped Build 1,000 MW of New Renewable Energy Projects in Texas", R. L. Lehr

Borchers et al, 2007

- Surveyed residents of New Castle County, Delaware
- Focused on type of energy source (solar, wind etc)

- Findings
  - Solar most popular option, wind second
  - Biomass had low WTP values

Other market research results

- Portland General Electric study showed that 41% of customers preferred solar over all other sources of renewables
- Colorado homeowner survey showed that 76% are willing to pay at least $1 a month for RE
- Seattle City Light customers prefer that cost of RE generation be shared among all

Discussion

- Values of WTP
  - Farhar: $5- 10 / month
  - Lehr: $1.50 – 6.50 / month
  - There are slight variations but similar findings in other studies

- WTP values are **high enough** to fund FIT implementation in the U.S

Discussion

- Variations in WTP values
  - Resource type
    - Solar had the highest values, followed by wind

- Although solar is the one of the costlier types of renewables, electricity price differentiation would be possible

Discussion

- Other sources of variations
  - Education vs. WTP
    - In all studies, informative discussions led to higher values of WTP
  - Demographics
    - Higher income / education level correlated with higher WTP values
  - Regional
    - Northeast and Northwest with relatively higher WTP values
    - Comparatively lower support in Southeast

Discussion

- Other customer preference patterns
  - Steadier energy costs are preferred
    - Favorable to FIT-type scheme since price volatility can be minimized through predetermined RE prices
  - Customers think cost of supporting renewables should be shared by all
    - Preference for broader policy support schemes than what is in place now

Discussion

- Studies show consumer preference favorable for FIT-type scheme
  - WTP values are high enough for FIT (In Germany FIT resulted in price hike of several Euros/month)
  - Different WTP among sources (solar vs. biomass) corresponds with design feature of FIT
    - Esp. for solar which has higher cost of production
  - Preference for steadier energy costs
  - Preference for cost sharing by all

Discussion

- Education impacts WTP values significantly
  - In all studies, informative discussion sessions led to higher WTP values by participants
- Significant differences in WTP by education, income, region
  - Educational efforts should take into account different degrees of WTP

Areas of further research

- Other factors that may influence WTP values
  - Economic downturn
    - Income reduction vs. job creation argument
  - Administration change and focus on energy policy

- Effective educational programs
  - How to account for variations in attitudes toward renewables

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