Disclaimer: The views expressed are those of Paul Gipe and are not necessarily those of the sponsor.

Disclosure: Paul Gipe has worked with Aerovironment, ANZSES, APROMA, ASES, AusWEA, AWEA, BWEA, BWE, CanWEA, CAW, DGW, DSF, EECA, ES&T, GEO, GPI Atlantic, IREQ, KWEA, MADE, Microsoft, ManSEA, NRCan, NRG Systems, NASA, NREL, NZWEA, ORWWG, OSEA, PG&E, SeaWest, SEI, USDOE, WAWWG, the Folkecenter, the Izaak Walton League, the Minnesota Project, the Sierra Club, and Zond Systems, and written for magazines in the USA, Canada, France, Denmark, and Germany.
Advanced Renewable Tariffs
The Most Effective Method for Rapidly Developing Renewable Energy
The Troika of Meeting Demand

- Conservation
  #1 Use Less
- Improved Efficiency
  #2 Do More with Less*
- Renewable Energy
  #3 Invest in the Future

*Buckminster Fuller
## Typical Household Consumption

<table>
<thead>
<tr>
<th>Location</th>
<th>kWh/yr/home</th>
</tr>
</thead>
<tbody>
<tr>
<td>Texas</td>
<td>14,000</td>
</tr>
<tr>
<td>Ontario</td>
<td>10,000</td>
</tr>
<tr>
<td>California</td>
<td>6,500</td>
</tr>
<tr>
<td>Netherlands</td>
<td>3,000</td>
</tr>
</tbody>
</table>
Swept Area per Household

Texas
Ontario
California
Germany
Wind Energy Has Come of Age
We Know What Works
...and What Doesn’t

Eole, Cap Chat
2005 World Wind Capacity

9,150 MW  41,000 MW

7,800 MW
World Major Wind Markets

Thousand MW in 2005

- Denmark
- India
- USA
- Spain
- Germany

Year:
- 80
- 81
- 82
- 83
- 84
- 85
- 86
- 87
- 88
- 89
- 90
- 91
- 92
- 93
- 94
- 95
- 96
- 97
- 98
- 99
- 00
- 01
- 02
- 03
- 04
- 05
Wind Energy is a Real Business
US$22 Billion in 2005

- Project Development: 53%
- Electricity Sales: 42%
- O&M: 5%
Wind Growing Rapidly 2003-2005

- Germany: ~2,100 MW/yr
  20,000 MW by 2006
  30,000 MW by 2012
- Spain: ~1,800 MW/yr
- USA: ~1,500 MW/yr
- Growth: 20%-40%/yr
Installed Wind Capacity 2005
Where Wisconsin Stands

- Germany
- Spain
- USA
- Denmark
- California
- Texas
- Minnesota
- Wisconsin

Megawatts (Thousands)
Solar PV Growing Rapidly

- 2005: 3,500 MW Worldwide
- 1,200 MW/yr
- $20+ Billion
- **Major Markets**
  - Germany -- 600+ MW/yr
  - Japan -- 350 MW/yr
  - Spain -- 100 MW/yr?
  - California -- 40 MW/yr

Rancho Seco, California
Solar Photovoltaics Development

Total Installed MW

- Canada
- USA
- Germany
- Japan

Year: 1990-2005

- 1990: 0 MW
- 2005: 1600 MW

Total Installed MW over the years for Canada, USA, Germany, and Japan.
Installed Solar PV Capacity 2005
Where Wisconsin Stands

Cumulative MW

Germany
Japan
USA
California
Spain
Wisconsin

0 200 400 600 800 1000 1200 1400 1600
Era of Distributed Generation

- Here Now
- Resilient, Not Brittle
- Short Lead Times
- Near Load, Less Losses
- Opportunity for Many
- Fosters Energy Awareness

Alberta, Canada

Ontario, Canada
Distributed Capacity... Small Projects

<table>
<thead>
<tr>
<th>kV</th>
<th>MW</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>6-10</td>
</tr>
<tr>
<td>45</td>
<td>15-20</td>
</tr>
</tbody>
</table>
Wind is Modular

- Quickly Installed
- When Needed
- As Needed
- Where Needed
- By Anyone

Tehachapi, California
Wind is Flexible

- **Scale**
  Big or Small Projects

- **Location**
  Near or Far

- **Time**
  Short Lead Times

- **Ownership**
  Local or Absentee
Höhe Westerwald, Germany

Setting the Stage
North American Energy Policy

North Americans are Dabbling Around the Edges of Renewable Energy Policy

Little Recognition of the Crisis Facing the Continent
North American Energy Policy

• Oil: War in Iran? Venezuela?
• Oil: $60-$70/bbl; $100/bbl Possible?
• Tar Sands to the Rescue?
• Gas: Canada Post Peak
• Gas: $40/mmBtu in Britain Winter 2006
• LNG Terminals to the Rescue?
• Climate Change--Very Costly
North American Energy Policy

• Situation is Serious . . .
• BAU--No Longer an Option
  Narrow Time Window for Action
• Need Rapid Deployment of Massive Amounts of Renewables Now
• There’s No Alternative
• “There’s No Time to Waste”
  Hermann Scheer MdB
North American Energy Policy for Distributed Renewables

- Hodgepodge of Grants, Rebates, Buy-Downs (Capital Subsidies)
- Sound Good on Paper
  - “Cubicle Thinking”
- Limited Effectiveness
  - Project Caps
  - Program Caps
  - Must Keep Going to the Well
Complacency is Not a Policy

Inaction is Not an Option
What Are Our Goals?

• **Primary**
  High Penetration Quickly

• **Secondary**
  Equitably Distributed Ownership
  Rural Development
  Sustainable Manufacturing
  Distributed Generation
  Improve Resiliency
  Reduce Transmission Losses
  Firm-Up Wind’s Variability
Renewable Tariffs
The Philosophical Context

Geothermal: Colline Metallifere, Italy
1. Do We Want Renewables?

- Peak Oil, Peak Gas
  Marginal Costs Higher Than Embedded Costs
- Nuclear Problematic
- Kyoto & Climate Catastrophe
  France & Italy, 2003; 25,000 Dead
- Public Support High
  Large Crowds in Ontario
- Desire for New Manufacturing Jobs
2. If Yes, Then What Works Best?

- How To Assign Contracts (PPAs)
  - Negotiated
  - Tendered
  - Standard Offers (Open)

- Who Gets Contracts
  - Elite Few or All Who Want Them?

- How To Pay For Them
  - RECs/ROCs/Green Tags
  - Capital or Production Subsidies
  - PTC or WPPI
  - Advanced Renewable Tariffs
3. If Using a Market Model, Then

• You Get What You Pay For
• If You Want It You Must Pay For It
• Difference Between Cost & Price
  Profit Margin Determines Rate of Growth
• High or “Premium” Prices Deliver
  More Generation
  More Quickly
  More Manufacturing . . . And More Jobs
Justification for Premium Prices

- European Court Ruling
  Under Market “Liberalization” Rules
- Offsets External Costs
  \( \text{SO}_x \) & \( \text{NO}_x \)
  \( \text{CO}_2 \) & Climate Change Very Expensive
- Country Specific Justification
  Dutch MEP, Spain’s Bonus, Germany’s EEG
Justification for Premium Prices

- **Strategic (Security) Value**
  - Not Subject to Embargo
  - Less Subject to Sabotage
  - Very Important to Europeans

- **Value of Distributed Generation**
  - Increased Resiliency

- **“It’s the Right Thing to Do”**
  - Gould, SCE, 1980s
Market Mechanism Status

• Premium Prices (Renewable Tariffs)
  Typically Non-Anglophone Countries

• Quotas & Tendering
  Typically Anglophone Countries
  Ireland, France & Britain (Failed)
  RPS in Most USA States
  Most Canadian Provinces

Haverigg, Cumbria, Britain
Why the European Success?

• #1 Community Involvement
  Germany & Denmark

• #2 Advanced Renewable Tariffs
  16 EU Countries use Electricity Feed Laws
Political Price-Political Quantity Markets

<table>
<thead>
<tr>
<th></th>
<th>Price</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feed Law</td>
<td>Political</td>
<td>Market</td>
</tr>
<tr>
<td>Quota/RPS/Tendering</td>
<td>Market</td>
<td>Political</td>
</tr>
</tbody>
</table>

Both are Market Mechanisms
Evolution of Market Mechanisms

- ARTs Developing Momentum
- RPS May Have Peaked
- Quota Exemplars Teetering

Carbon Trust & Britain’s RO
Italy’s Environment Minister & Feed Laws
EU Policy Mechanisms

Figure 4:
Price ranges (average to maximum support) for direct support of wind onshore in EU-15 Member States (average tariffs are indicative) compared to the long-term marginal generation costs (minimum to average costs). Support schemes are normalised to 15 years.
Barriers to Renewable Tariffs

• Philosophical: Cost vs Value
  Cost of Generation
  Value of Generation

• Sticker Shock
  Avg. Imbedded Costs & Heritage Resources
  NG: Future Pricing
  Nuclear: Cost Estimates & Reality
  Mega Wind Projects @ Windy Sites

• Unfamiliarity

• US Tax Subsidies (PTC) Distort Market

• Hard to Write a Press Release!
Combined Price Model?

- Market, Pool, or Wholesale Price + Variable With Changes in Market Price
  Market Price Can Be Manipulated (Ontario)
- Not Sufficiently Predictable
  Less Bankable Than Renewable Tariffs
- ARTs Ensure “Fair” Profitability
  But Limit Excessive Profits
- Consumers Can Be Insulated
  ARTs Costs Can Become Rents (Positive)
Advanced Renewable Tariffs

• What Are They?
  Feed Laws or Minimum Price Systems
  Political Price, Not Political Quota
  Simple Contracts

• How Do They Work?
  Simple, Comprehensible, Transparent
  Little Administration

• Where?

Paul Gipe & Assoc.
# Renewable Energy Tariffs Status

<table>
<thead>
<tr>
<th>Existing Standard</th>
<th>Existing Non-Standard</th>
<th>Regulations Pending</th>
<th>Proposed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>Minnesota C-BED</td>
<td>Czech Republic</td>
<td>Japan</td>
</tr>
<tr>
<td>Brazil</td>
<td>PEI, Canada</td>
<td>Hungary</td>
<td>Italy?</td>
</tr>
<tr>
<td>California (PV)</td>
<td>The Netherlands</td>
<td>Ireland</td>
<td></td>
</tr>
<tr>
<td>France</td>
<td>Washington State</td>
<td>Turkey (Wind)</td>
<td></td>
</tr>
<tr>
<td>Germany</td>
<td></td>
<td>Ontario</td>
<td></td>
</tr>
<tr>
<td>Greece</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Italy (PV)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Portugal</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spain</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Renewables in Germany 2006
~67 TWh

- Hydro: 21.7 TWh
- Wind: 33 TWh
- Biomass: 11 TWh
- Solar PV: 1 TWh
German Solar Granny Flat
German Farms . . .
. . . Solar PV Cash Crop

• 200 MW on Barn Roof Tops in 2005
Solar PV in Germany 2005

- 75,000 New Systems
- €3 Billion
- Total of 200,000 Systems
- 600+ MW in 2005
- Total 1,500 MW
- Costs Dropped 25%
- 200 MW by Farmers!

On Barn Roofs, 30 kW each
Germany’s Renewable Tariffs
The Results (2005)

- Renewables 10% of Supply
- Renewables Generating 60 TWh/yr
- 45,000 Employed in Wind Industry
- 30,000 Employed in PV Industry
- 8,000 Employed in Biogas Industry
- 170,000 Employed in Renewables
- €16.4 Billion Turnover
Germany’s Renewable Tariffs
The Results

- Renewables ~60 TWh/yr
- 200,000 PV Installations
- 2,000 Biomass Plants
- 550 MW Farm Biogas, 10 TWh/yr
- 6,000 Hydro Plants
- 18,000 Wind Turbines
- Total of 235,000 Generators!

DeWind
Cost of German EEG

- Generation: 60%
- EEG: 3%
- Eco Tax: 11%
- CHP Act: 2%
- Concession: 10%
- VAT: 14%
## German EEG Differential Cost to Residential Ratepayers

<table>
<thead>
<tr>
<th>Year</th>
<th>Euro/y</th>
<th>Euro/kWh</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>18</td>
<td>0.005</td>
</tr>
<tr>
<td>2020</td>
<td>32.4</td>
<td>0.008</td>
</tr>
</tbody>
</table>
Advanced Renewable Tariffs in Germany

- Obligation to Interconnect
- Obligation for Priority Purchase
- Obligation to Pay Fixed Tariffs
- Tariffs Vary by Technology, Location (Energy Content or Specific Yield), Size (for Some Technologies)
# German EEG Solar Tariffs

<table>
<thead>
<tr>
<th></th>
<th>Euros/kWh</th>
<th>CAD/kWh</th>
<th>USD/kWh</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;30 kW rooftop</td>
<td>0.574</td>
<td>0.807</td>
<td>0.691</td>
</tr>
<tr>
<td>&lt;100 kW rooftop</td>
<td>0.546</td>
<td>0.767</td>
<td>0.657</td>
</tr>
<tr>
<td>&gt;100 kW rooftop</td>
<td>0.54</td>
<td>0.759</td>
<td>0.65</td>
</tr>
<tr>
<td>Freestanding</td>
<td>0.457</td>
<td>0.642</td>
<td>0.55</td>
</tr>
<tr>
<td>Facade cladding</td>
<td>0.5</td>
<td>0.703</td>
<td>0.602</td>
</tr>
</tbody>
</table>
German Wind Tariffs
Reference Yield Method

Euro Cents/kWh

Year

150%
100%
60%

OSEA
German EEG Tariff Review

- Review Every 2 Years, Now 3 Years
- Next Review 2007
- BMU Hires Consultant
- Each Interest Group Prepares Report or Hires Consultant (Deutche Windguard)
- Wind Reports w/ Detailed Data
- Wind: 12% ROI Target
  Loan 10 y; Equity 30%;
French Advanced Renewable Tariffs
**Profitability Index (NPV/I)**

The Universal Profitability Index Scale

<table>
<thead>
<tr>
<th>-0.1</th>
<th>0</th>
<th>0.1</th>
<th>.2</th>
<th>0.3</th>
<th>0.4</th>
<th>0.5</th>
<th>0.6</th>
<th>0.7+</th>
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</thead>
<tbody>
<tr>
<td>Not</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>profitable</td>
<td>Too low profitability levels</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>No potential growth</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Risks of stranded costs:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Very high</td>
<td>High</td>
<td>Low</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Defensive Growth</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Aggressive growth</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Leadership</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Crash programme</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Bernard Chabot, ADEME
France

- <12 MW Renewable Tariff
  Historical-Political Reasons for 12 MW
- >12 MW Negotiated PPA
- Fair Profits at Medium Wind Sites
  6 m/s at Hub Height
- Not “Undue” Profits at High Wind Sites
  8.5 m/s at Hub Height
France

- Initially Limited to 1,500 MW
  Led to Wind Rush
- Price Adjusted for Inflation 60%
- Profitability Index Method (Chabot)
- Use of Capacity Factor Led to Gaming
- Planning Conflicts Slowed Growth
- Pro-Nuclear Policy Supports Anti-Wind Movement
French Wind Tariffs
Profitability Index Method

Year

Euro Cents/kWh

23% CF
30% CF
41% CF
French Wind Tariffs 2006

Linear interpolation between full-load hours.
# French Advanced Renewable Tariffs 2006 Summary

<table>
<thead>
<tr>
<th>Energy Source</th>
<th>Years</th>
<th>Euros/kWh</th>
<th>CAD/kWh</th>
<th>USD/kWh</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind on shore</td>
<td>15</td>
<td>0.082</td>
<td>0.118</td>
<td>0.104</td>
</tr>
<tr>
<td>Wind off shore</td>
<td>15</td>
<td>0.13</td>
<td>0.187</td>
<td>0.164</td>
</tr>
<tr>
<td>Solar PV*</td>
<td>20</td>
<td>0.3</td>
<td>0.431</td>
<td>0.379</td>
</tr>
<tr>
<td>Integrated Solar PV</td>
<td>20</td>
<td>0.55</td>
<td>0.79</td>
<td>0.695</td>
</tr>
<tr>
<td>Solar PV Rhone-Alps</td>
<td>6</td>
<td>0.6</td>
<td>0.862</td>
<td>0.758</td>
</tr>
<tr>
<td>Biogas &lt;150 kW</td>
<td>15</td>
<td>0.103</td>
<td>0.148</td>
<td>0.13</td>
</tr>
</tbody>
</table>

*Plus 50% tax credit on hardware for residential use up to ~ 3 kW.*
Emerging ARTs Markets 2006

- **France** 750 MW
  - 3,000 MW Queue
  - 90% Wind
- **Ontario**
  - 200 Applicants
  - ~2,000 MW Potential
  - Mostly Wind

Cros de Georand, France
Renewable Tariffs: Trend Growing in North America?

Husum, Germany
Renewable Tariffs in North America . . Unthinkable?

- Yes--Just 2 years ago
- Today? No
- Now Possible
- Growing Trend in both USA & Canada

Paul Gipe & Assoc.

WindShare, Toronto
Willingness to Pay Premium . . . Unthinkable?

- PEI Gasoline Price Regulation
- NS Premier Hamm Proposes Gasoline Price Regulation
- Local Content (Quebec)
- Why?
  Social Economy-Jobs
  Rural Development

Paul Gipe & Assoc.  Halifax Herald, May 20, 2005
California’s Original Wind Tariff
Interim Standard Offer Contract #4

- 1983: ISO4
- Commercial Wind Industry Begins
- 1985: ISO4 Suspended
  No New Contracts
- 1984-1990: ~1,500 MW of Wind Installed
- Wind Generates ~1% of Supply
Advanced Renewable Tariffs
North American Endorsements

• Ontario
  Liberal Party, 2004
  Green Party, 2006
  Ontario Premier, March 21, 2006

• Canada’s Federal NDP 2006

• NGOs
  NFU, GLU, BCWEA, CanWEA, CanSIA
  Sierra Club (USA), DSF (Canada)

Ferndale, Ontario
Advanced Renewable Tariffs

• Momentum in North America
  Prince Edward Island (Canada)
  Washington State (PV)
  Minnesota C-BED
  California (PV)
  Ontario (<10 MW)

• Desire for Manufacturing Jobs

• Awareness That ARTs Deliver
Renewable Tariff Design

- Simple, Comprehensible, & Transparent
- Simplified Interconnection
- Prices Sufficient to Drive Development
- Lengths Sufficient for Profitability
- Prices Differentiated by Technology
- Prices Differentiated by Resource
Renewable Tariff Design

- Price Sufficient to Drive Development
- Fair But Not Undue Profit
- Hoarding & Speculation
  - Caps Lead to Speculation
- Sufficiently Differentiated
  - For Differing Technologies
  - For Differing Sizes & Regions
  - For Differing Resource Intensities
Renewable Tariff Design
Periodic Review

• A “Wise & Prudent” Policy
• Ensures Prices are Right
• Ensures that the Program is “Robust Enough”

Hamburg Landfill, Germany
Renewable Tariff Design
Tiered Tariffs for Wind

• Distributed Benefits
  Only Accrue From Distributed Generation
  Mega Wind = Centralized Generation

• Tiered Tariffs Distribute Wind Development

• Reduces Pressure on Windiest Sites
  Profitability Still Higher at Windy Sites

• Reduces NIMBYism
  By Enabling Greater Participation
  By Reducing Pressure on Wind Ghettos
Renewable Tariff Design
Tiered Tariffs for Wind

• Increases Program Flexibility
  Lessens Pressure to Get Prices Right the First Time

• Reduces Development Risk
  Developers Often Over Estimate Production
  Determining Final (T2) Price After 5 Years of Operation

• Spreads Opportunity to All
  Not Just to Elite Few

• Provides Fair Profits at Modest Wind Sites

• Limits "Excessive Profits" at Windy Sites
## Renewable Energy Tariffs

### Contract Length

<table>
<thead>
<tr>
<th>Country</th>
<th>Wind</th>
<th>Photovoltaics</th>
<th>Hydro</th>
<th>Biomass</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>13</td>
<td></td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Brazil</td>
<td>20</td>
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<td>California</td>
<td></td>
<td>3</td>
<td>20</td>
<td>20</td>
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<tr>
<td>California SO4 (old)*</td>
<td>10</td>
<td>10</td>
<td>10</td>
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<td>Czech Republic</td>
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<td>France</td>
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<td>Germany</td>
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<td>20</td>
<td>15-30</td>
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<td>Italy</td>
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<td>Minnesota</td>
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<td>20</td>
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<tr>
<td>Portugal</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td></td>
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<tr>
<td>Spain***</td>
<td>&gt;15</td>
<td>&gt;25</td>
<td>&gt;25</td>
<td>&gt;20</td>
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<tr>
<td>Turkey</td>
<td>7</td>
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<td>20</td>
<td>20</td>
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<tr>
<td>Washington State</td>
<td>9</td>
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</table>

***Spain: Life of Plant.***
## Renewable Tariffs Inflation Adjustment

<table>
<thead>
<tr>
<th>Location</th>
<th>Inflation Adjustment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Germany</td>
<td>0%</td>
</tr>
<tr>
<td>Ontario RFP</td>
<td>15%</td>
</tr>
<tr>
<td>Ontario SOC</td>
<td>20%</td>
</tr>
<tr>
<td>Prince Edward Island</td>
<td>26%</td>
</tr>
<tr>
<td>France</td>
<td>60%</td>
</tr>
<tr>
<td>Spain</td>
<td>100%</td>
</tr>
<tr>
<td>California FSO4</td>
<td>Ramped for Inflation</td>
</tr>
<tr>
<td>Country</td>
<td>Wind</td>
</tr>
<tr>
<td>--------------</td>
<td>--------</td>
</tr>
<tr>
<td>Austria</td>
<td></td>
</tr>
<tr>
<td>Brazil</td>
<td>1,100 MW</td>
</tr>
<tr>
<td>California**</td>
<td></td>
</tr>
<tr>
<td>Denmark</td>
<td>20%</td>
</tr>
<tr>
<td>France</td>
<td>17,000 MW</td>
</tr>
<tr>
<td>Germany</td>
<td>No Limit</td>
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<td>Italy</td>
<td></td>
</tr>
<tr>
<td>Minnesota</td>
<td>No Limit</td>
</tr>
<tr>
<td>Ontario</td>
<td>No Limit</td>
</tr>
<tr>
<td>South Korea</td>
<td></td>
</tr>
<tr>
<td>Spain</td>
<td>20,000 MW</td>
</tr>
</tbody>
</table>
Renewable Tariff Design

- **PGC/SBC Funds Insufficient**
  Must Keep Going to the Till
  Gaming, Over Subscription

- **Should Avoid Using PTC**
  Unreliable & Distorts Market

- **Or, Tariffs Must be Flexible**
  With or Without PTC or Other Federal Subsidies

- **Renewables Must be Rate Based**
  Assured Stream of Payments
  History of Cost-Based Pricing
Washington State Tariff

- Solar PV, Small Wind, & Biogas
- Contract Length: 9 years
- $0.54/kWh + $0.08/kWh = $0.062/kWh
- Must be Built in State
- Max $2,000/Customer/yr
- Max 25 kW (net-metered)
- Small Wind
  - $0.33/kWh + $0.08/kWh = $0.41/kWh

Paul Gipe & Assoc.
Washington State Tariff Limitations

- Limited Contract Length
- Limited Size (25 kW)
- Limit on Total Program Size
- Based on “Early Adopters”
- Assumes
  - Renewable Costs will Fall Dramatically
  - Costs of Conventional Sources will Rise

Paul Gipe & Assoc.
PEI Energy Act

- MPS System
  ~$0.0775 CAD/kWh
  20 year Contracts
  Some Restrictions
  Program Review 5 yrs
  $0.02/kWh of Tariff
  Adjusted with Inflation

Paul Gipe & Assoc.

North Cape, PEI
California Performance-Based Incentive

- Solar PV Only January 2005
- $0.50/kWh for 3 yrs Only
- ~$400,000 Project Cap
- ~$10 million Program Cap
- Meter Read by Utility or Web Monitoring
Minnesota’s Community-Based Energy Development (C-BED)

- Became Law Spring 2005
- NPV Payment Stream
- Voluntary Utility Participation
- Discount Rate Determined
- Negotiated Tariffs
- To Provide NPV of $0.027 USD/kWh
- 20 Year Contracts
Minnesota’s Community-Based Energy Development (C-BED)

- 100 MW Signed Contracts
- 300 MW “On the Table”
- 900 Applications
- PUC Approves Each Contract
- No Capacity Limit
- Must be Structured To Statute
- Excel (NSP) 500 MW C-BED by 2010
- Governor 800 MW C-Bed by 2010
Minnesota’s Community-Based Energy Development (C-BED)

- Intended for Locally-Owned Wind
- Depends upon Aggressive Tax Design
- Depends upon High Wind Speeds
- Depends upon Limited Cost Analysis
- Higher Costs Could Hurt Effectiveness
- O&M Too Low?
- Revenue Stream Very Low in Later Years
Advanced Renewable Tariffs
Ontario Pilot Program

- 20 Year Fixed-Price Contract
- Distribution Voltage <44kV
- Tariffs for Wind, Solar, Hydro, Biomass
- Wind Tariffs
  - Low, Medium, High Wind
- Inclusive--Open to All
- Streamlined Interconnection
- 5-Year Pilot Program
Advanced Renewable Tariffs
Ontario Pilot Program

• No MW cap, Time Limit Cap
• Project Limit: ~10 MW, “Last Turbine In”
• Contracts Executed within 2 Years
• Review after 2 Years
• Full Review after 5 Years

Paul Gipe & Assoc.
## Advanced Renewable Tariffs
### Ontario Pilot Program

<table>
<thead>
<tr>
<th></th>
<th>Initial Price ($CAD/kWh)</th>
<th>Average Price (Teq) ($CAD/kWh)</th>
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<tr>
<td>Wind 1-5 (T1)</td>
<td>0.133</td>
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</tr>
<tr>
<td>High Wind (T2)</td>
<td>0.069</td>
<td>0.091</td>
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<td>Medium Wind (T2)</td>
<td>0.09</td>
<td>0.105</td>
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<td>Base Wind (T2)</td>
<td>0.133</td>
<td>0.133</td>
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<td>Solar PV</td>
<td>0.83</td>
<td>0.83</td>
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<tr>
<td>Solar PV (Soft Loans)</td>
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<td>0.67</td>
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<tr>
<td>Biomass</td>
<td>0.133</td>
<td>0.133</td>
</tr>
<tr>
<td>Small Hydro</td>
<td>0.133</td>
<td>0.133</td>
</tr>
</tbody>
</table>
Standard Offer Contract
Base Wind Case

$CAD/kWh

Base Wind (<650 kWh/m2/yr)

Paul Gipe & Assoc.
Standard Offer Contract
High Wind Case

$CAD/kWh

High Wind (>1,100 kWh/m²/yr)

Paul Gipe & Assoc.
Ontario SOC/ARTs
What We Got

- Wind Energy Tariff: $0.11/kWh
- Hydro & Biomass Tariff: $0.11/kWh
- Hydro & Biomass: $0.0352/kWh on peak
- Solar Photovoltaics Tariff: $0.42/kWh
- Inflation Adjustment: 20%, Excluding Solar PV
- Term of Contracts: 20 years
Ontario SOC/ARTs
What We Got

• Project Size Limit: 10 MW (Max.)
• Contracts are Open to All
• Simplified Interconnection?
• No Cap or Limit on the Program
• All after January 1, 2000 Included
• Program Review Every Two Years
• Contracts Fall 2006 (PV Later?)
Ontario Power Authority
SOC Pricing--Their Version

- Retail Tariff: ~$0.08/kWh
- RFP I: $0.085/kWh
- RFP II: $0.095/kWh
- Range: +/- $0.01/kWh
- Distributed Benefits: $0.01/kWh
- In the End a Purely Political Decision
- “Optics” of $0.011/kWh “Acceptable”
Ontario Power Authority
SOC Pricing--OSEA’s Version

- Struggle Between OPA & MoE over Control of Pricing
- OPA Met with Senior Staff in Premier’s Office
- Premier’s Office Determined “Optics” and Politically Acceptable Price
- OPA Then Wrote Justification
OSEA-CanSIA Solar PV Pricing

- Chabot: $0.83/kWh
- Chabot: $0.67/kWh w/ Soft Loans
- CanSIA Price Justification
  - $0.22/kWh Distributed Generation Benefits
  - Plus $0.20/kWh Peak Period Price
    = $0.42/kWh
- CanSIA True Price Determination
  OSEA Price Too High = Too Much Growth!
  1/2 OSEA Price = $0.42/kWh
Ontario Solar Tariff
North American Comparison

$ USD/kWh Over 20 Years

- California Buy-Down
- California Solar Tariff
- Washington State
- New Jersey RPS
- Wisconsin
- Ontario Solar Tariff
Ontario Renewable Tariffs Comparison

Prices Paid for Wind Energy in Europe

Euro Cents/kWh

- Feed Law-Germany
- Feed Law-France
- Feed Law-Spain
- Quota-Italy
- Quota-Britain
- Feed Law-Ontario

2006
Prices Paid for Hydro in Europe

Euro Cents/kWh

- Feed Law-Germany
- Feed Law-France
- Feed Law-Spain
- Quota-Italy
- Quota-Britain
- Feed Law-Ontario
Prices Paid for Biomass in Europe

- Feed Law-Germany
- Feed Law-France
- Feed Law-France
- Feed Law-Spain
- Quota-Italy
- Quota-Britain
- Feed Law-Austria
- Feed Law-Ontario

Euro Cents/kWh

0  5  10  15  20
Prices Paid for Solar PV in Europe

Euro Cents/kWh

Feed Law-Germany
Feed Law-France
Feed Law-Spain
Feed Law-Italy
Quota-Britain
Feed Law-Austria
Feed Law-Ontario

0 10 20 30 40 50 60 70
Ontario’s SOCs: What’s Wrong?

• Tariffs Too Low
  PV: 50% of What’s Needed
  Wind: Only Windy Sites (6.4 m/s)
  Biomass: $0.17 CAD/kWh MoAF

• Inflation Adjustment Too Low
  20% vs 50%: -2.5% ROI
  Set on “Portion of O&M” Influenced by Inflation

• WPPI Claw Back
  Could be Problematic--We May Still Get It
Ontario’s SOCs: What’s Wrong?

- Wind Tariff Tiering
  Not Enough at Less Windy Sites
  Too Much at Windy Sites?
- Fundamental Philosophical Shift
  Cost vs Value Debate Continues
  Minister of Energy--Yes
  OPA--Absolutely, Positively No!
Ontario’s SOCs: What’s Wrong?

• OSEA Lost the Language Battle
• Language Frames the Debate
  Difficult to Reclaim Once Lost
• Language--Not an Insignificant Issue
  Feed Law --> Renewable Tariffs --> ARTs
  ARTs are not SOCS
  SOCS = Standard Contracts
  ARTs Not Standard--Differ by Technology
• Stick with Feed Law or ARTs
  Production-Based Incentives
Ontario SOC/ARTs Results (Since March 2006)

- Residential PV Sales: 250 kW
- Commercial PV Sales: 250 kW
- 20X Annual Ontario PV Sales
- 5 X Annual Canadian On-Grid PV Sales!
- Wind: 240 Grid Applications
  @10 MW/ea ~2,500 MW
Wisconsin Renewable Tariffs Examples

- Wind
- Solar PV
Wind Speed m/s @ 80m
## North American Mid-Continent Wind Sites

<table>
<thead>
<tr>
<th>Site</th>
<th>State</th>
<th>Diameter</th>
<th>Height</th>
<th>Avg. Yield kWh/m²/yr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kincardine</td>
<td>ON</td>
<td>43</td>
<td>50</td>
<td>792</td>
</tr>
<tr>
<td>Toronto</td>
<td>ON</td>
<td>52</td>
<td>65</td>
<td>474</td>
</tr>
<tr>
<td>Ontario #1</td>
<td>ON</td>
<td>80</td>
<td>78</td>
<td>833</td>
</tr>
<tr>
<td>Bowling Green</td>
<td>OH</td>
<td>80</td>
<td>78</td>
<td>809</td>
</tr>
<tr>
<td>Hull</td>
<td>MA</td>
<td>47</td>
<td></td>
<td>893</td>
</tr>
</tbody>
</table>
## Wisconsin Wind Yields

### Wisconsin Productivity & Yields

Yields from 65m to 80m derived from actual performance.

<table>
<thead>
<tr>
<th></th>
<th>1998-2004</th>
<th></th>
<th></th>
</tr>
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<tbody>
<tr>
<td></td>
<td>65m</td>
<td>80m</td>
<td>(\alpha)</td>
</tr>
<tr>
<td></td>
<td>Annual Specific Yield Average</td>
<td>kWh/m²/y</td>
<td>kWh/m²</td>
</tr>
<tr>
<td>TVP De Pere</td>
<td>756</td>
<td>857</td>
<td>0.2</td>
</tr>
<tr>
<td>WPS Lincoln</td>
<td>746</td>
<td>845</td>
<td></td>
</tr>
<tr>
<td>MG&amp;E Rosiere</td>
<td>750</td>
<td>849</td>
<td></td>
</tr>
<tr>
<td>WEPCo Byron (Decker)</td>
<td>893</td>
<td>1012</td>
<td></td>
</tr>
<tr>
<td>Montfort</td>
<td>773</td>
<td>875</td>
<td></td>
</tr>
</tbody>
</table>

**Warning:** Performance decreases at higher average wind speeds as more time is spent at higher wind speeds. Increase in yield is calculated as \(1.13 \times 65m\) yield. This may be optimistic. 10% is more reasonable.
### Wisconsin Wind Data

Calculated Gross Single Turbine Yields at 80m

<table>
<thead>
<tr>
<th>Site #</th>
<th>Site Name</th>
<th>$\alpha$</th>
<th>Specific Yield</th>
<th>Possible Losses</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>0.2</td>
<td>m/s</td>
<td>kWh/m²/yr -5%</td>
</tr>
<tr>
<td>409</td>
<td>Honeymoon Hill</td>
<td>7.7</td>
<td>1,260</td>
<td>1,197</td>
</tr>
<tr>
<td>408</td>
<td>Eden</td>
<td>7.3</td>
<td>1,170</td>
<td>1,111</td>
</tr>
<tr>
<td>410</td>
<td>Wind Shear Study*</td>
<td>7.2</td>
<td>1,150</td>
<td>1,092</td>
</tr>
<tr>
<td>411</td>
<td>Clay Banks</td>
<td>7.2</td>
<td>1,150</td>
<td>1,092</td>
</tr>
<tr>
<td>402</td>
<td>Abbotsford</td>
<td>6.8</td>
<td>1,000</td>
<td>950</td>
</tr>
<tr>
<td>413</td>
<td>Hurley</td>
<td>7.1</td>
<td>1,090</td>
<td>1,035</td>
</tr>
<tr>
<td>407</td>
<td>Rock River</td>
<td>6.9</td>
<td>1,030</td>
<td>978</td>
</tr>
<tr>
<td>406</td>
<td>Montfort</td>
<td>6.7</td>
<td>970</td>
<td>921</td>
</tr>
<tr>
<td>405</td>
<td>Sturgeon Bay</td>
<td>7.0</td>
<td>1,060</td>
<td>1,007</td>
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<tr>
<td>414</td>
<td>DeForest</td>
<td>6.5</td>
<td>910</td>
<td>864</td>
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<td>401</td>
<td>Spring Valley</td>
<td>6.3</td>
<td>880</td>
<td>836</td>
</tr>
<tr>
<td>412</td>
<td>Tomah</td>
<td>6.6</td>
<td>940</td>
<td>893</td>
</tr>
<tr>
<td>404</td>
<td>Cornucopia</td>
<td>5.7</td>
<td>700</td>
<td>665</td>
</tr>
<tr>
<td>403</td>
<td>Rib Lake</td>
<td>5.6</td>
<td>670</td>
<td>636</td>
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</table>
Annual Yield @ 80m

~Average Annual Specific Yield kWh/m²/yr

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
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<tbody>
<tr>
<td>630</td>
<td>980</td>
<td>790</td>
<td>600</td>
<td>900</td>
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<tr>
<td>600</td>
<td>950</td>
<td>900</td>
<td>950</td>
<td>950</td>
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<tr>
<td>790</td>
<td>746</td>
<td>750</td>
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<tr>
<td>875</td>
<td>927</td>
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<tr>
<td>820</td>
<td>893</td>
<td>893</td>
<td>893</td>
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<tr>
<td>773</td>
<td>773</td>
<td>773</td>
<td>773</td>
<td>773</td>
</tr>
</tbody>
</table>
## Tariff Calculation Using Chabot Profitability Index Method

*Adapted by Paul Gipe, pgipe@igc.org*

Enter Data in These Cells.

### Average Weighted Cost of Capital Before Tax

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Equity</td>
<td>13.0%</td>
</tr>
<tr>
<td>Return on Equity</td>
<td>20%</td>
</tr>
<tr>
<td>Debt</td>
<td>80%</td>
</tr>
<tr>
<td>Interest on Debt</td>
<td>7.00%</td>
</tr>
<tr>
<td>Nominal AWCC</td>
<td>8.2%</td>
</tr>
<tr>
<td>Inflation</td>
<td>3.0%</td>
</tr>
<tr>
<td>AWCC real</td>
<td>5.0%</td>
</tr>
</tbody>
</table>

### Data

- **Rotor Diameter**: 80 m
- **Rated Capacity**: 2,000 kW
- **Specific Installed Cost**: $700 $/m
- **Installed Cost**: $3,518,584
- **Annual Expenses**: $1,759 $/kW
- **Term**: 20 years
- **Discount Rate (AWCC)**: 5.0% real
- **Specific Yield**: 700 kWh/m2/y
- **Capital Recovery Factor (n,t)**: 0.0806
- **Profitability Index Target**: 0 NPV/I
- **Cost of Energy**: $0.121 $/kWh
- **Simple Payback**: 8.3 years

**Note**: Before tax, 100% Adjustment with Inflation.
Chabot-Gipe PIM Wind
Price Varies by Specific Cost

$/kWh

Specific Cost ($/m²)

650 675 700

725 750

PI=0.2, Before Taxes
Chabot-Gipe PIM Wind
Price Varies by Profitability Index

@US$700/m², Before Taxes
Example Wisconsin Tariff
Cash Flow Model w/ & w/o PTC

$\$/kWh

700 750 800 850 900 950 1000 1050 1100 1150 1200

Yield (kWh/m²/year)

@US$700/m², PI=0.3.
Example Wisconsin Wind Tariffs

@US$700/m², Before Taxes
## Wisconsin Sample PV Tariff

**Note:** Before tax, 100% Adjustment with Inflation. Enter Data in These Cells.

### Average Weighted Cost of Capital Before Tax

<table>
<thead>
<tr>
<th></th>
<th>Value</th>
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<tbody>
<tr>
<td>Equity</td>
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<tr>
<td>Return on Equity</td>
<td>13.0%</td>
</tr>
<tr>
<td>Debt</td>
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<tr>
<td>Interest on Debt</td>
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<tr>
<td>Nominal AWCC</td>
<td>8.2%</td>
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<tr>
<td>Inflation</td>
<td>3.0%</td>
</tr>
<tr>
<td>AWCC real</td>
<td>5.0%</td>
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</table>

<table>
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<th>Value</th>
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<td>$8,800</td>
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<td>Specific Installed Cost</td>
<td>$8,800/kW</td>
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<tr>
<td>Annual Expenses</td>
<td>$1,280</td>
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<td>Term</td>
<td>20 years</td>
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<td>Discount Rate (AWCC)</td>
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<tr>
<td>Specific Capacity</td>
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<tr>
<td>Capital Recovery Factor</td>
<td>0.0806</td>
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<td>Profitability Index Target</td>
<td>0 NPV/I</td>
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<tr>
<td>Cost of Energy</td>
<td>$0.657</td>
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<tr>
<td>Simple Payback</td>
<td>10.5</td>
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</tbody>
</table>

Compare with Germany ($0.654/kWh) and France ($0.695/kWh).
## Wisconsin PV Tariffs

### Wisconsin Proposed Renewable Tariffs

<table>
<thead>
<tr>
<th>Cash Flow Model</th>
<th>PI</th>
<th>With Subsidies</th>
<th>State</th>
<th>Federal</th>
<th>Without None</th>
<th>Chabot PIM</th>
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</thead>
<tbody>
<tr>
<td>Solar PV</td>
<td>NPV/I</td>
<td>$/kWh</td>
<td>$/kWh</td>
<td>$/kWh</td>
<td>$/kWh</td>
<td>$/kWh</td>
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<td>0</td>
<td>0.411</td>
<td>0.488</td>
<td>0.538</td>
<td>0.615</td>
<td>0.657</td>
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<tr>
<td>0.1</td>
<td>0.466</td>
<td>0.543</td>
<td>0.593</td>
<td>0.670</td>
<td>0.712</td>
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<td>0.2</td>
<td>0.521</td>
<td>0.598</td>
<td>0.648</td>
<td>0.726</td>
<td>0.768</td>
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</tr>
<tr>
<td>0.3</td>
<td>0.576</td>
<td>0.653</td>
<td>0.704</td>
<td>0.615</td>
<td>0.768</td>
<td></td>
</tr>
</tbody>
</table>

Constant Tariff, 20 years.

Tariff 100% Adjusted for Inflation.
How To Get There

Biogas Combined Heat & Power, Jutland, Denmark
How To Get There

• Federal Action
  Not Likely, Congress is Divided
  PTC Dependent Upon Periodic Budgeting

• State Action Most Likely
  Incorporate Environmental Values
  Internalize External Costs (Relatively)
  Independent of Budget
How To Get There

- Simple Contracts (PPAs)
- Available to All
  Some Restrictions May Apply
    Project Size Limit?
    Ownership Limits?
- Bankable Tariffs By Technology
  High Enough To Do Some Good
  No Tokenism
- Must Be Independent of PTC or WPPI
  PTC or WPPI Could be Refunded
How To Get There

• Need New Champions
  Washington/Ottawa of Little or No Help

• Need NGOs
  De-Emphasize Net Metering
  RPS (Minimum Target) with Renewable Tariffs

• Need Political Champions
  Governor’s or Premier’s Office
  Ontario Minister of Energy Donna Cansfield
  Political Party Leaders
Advanced Renewable Tariffs

The Method for Meeting Targets

• ARTs Compatible with RPS Targets
  Though ARTs Work Best w/o Caps
• ARTs Deliver More Capacity--
  --More Quickly
  --More Equitably

Paul Gipe & Assoc.
Renewable Tariffs--New Policy Option for North America

Freyssenet, France  
Paul Gipe & Assoc.
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