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, EECA, ES&T, GEO, GPI Atlantic, IREQ, KWEA, MADE, Microsoft, ManSEA, NRCan, NRG Systems, NASA, NREL, NZWEA, OSEA, ORWWG, OSEA, PG&E, SeaWest, SEI, the Folkecenter, the Izaak Walton League, the Minnesota Project, the Sierra Club, USDOE, WAWWG, and Zond Systems, and written for magazines in the USA, Canada, France, Denmark, and Germany.
Building a Sustainable Power Supply with Renewable Energy
Building a Sustainable Power Supply
by Cutting Demand
and Increasing the Use of
Renewable Energy
Not Quick, Not Cheap, Not Easy
But Worth Every Cent
Building a Sustainable Power Supply
By Cutting Demand

• Conservation
  Using Less
• Improved Efficiency
  Doing More with Less*
• Renewable Energy
  Investing in the Future

*Buckminster Fuller
<table>
<thead>
<tr>
<th></th>
<th>kWh/yr/home</th>
</tr>
</thead>
<tbody>
<tr>
<td>Texas</td>
<td>14,000</td>
</tr>
<tr>
<td>New Zealand</td>
<td>8,000</td>
</tr>
<tr>
<td>California</td>
<td>6,500</td>
</tr>
<tr>
<td>The Netherlands</td>
<td>3,000</td>
</tr>
</tbody>
</table>
Living Better on Less

- 10 Million California Households
- 2 x 100 W Bulbs
- 2 x 25 W CF
- 150 W Savings x 10 Million
- = 1,500 MW Savings!
Gipe-Nies Electricity Consumption

Month

January  February  March  April  May  June  July  August  September  October  November  December

kWh/month

2001
2002
5 yr Avg

Paul Gipe & Assoc.
The Result in California?

• 8-10% Savings
• We Coped with Crisis
• The Lights Stayed On
• Savings Permanent
• Cut Bills 20%
Wind Energy Has Come of Age
Montefalcone, Italy
Why Wind?

- Reduces Use of Nuclear & Fossil Fuels
- Most Cost-Effective of New Renewables
- Relatively Benign
Wind Energy’s Benefits

• Clean & Green (Mostly)
  No SO$_x$, NO$_x$, or CO$_2$
• Renewable
  Net Positive Energy Balance (4-6 months)
• Domestic: Not Subject to Embargo
• Does Not Consume Water
• Modular = Flexible
• ... and Can be Removed
Wind Energy’s Impacts

- Aesthetics or Intrusiveness
- Erosion & Scarring from Roads (Length, Width, Number and Slope)
- Shadow Flicker & Disco Effect
- Climate?
- Noise--They are Audible
- Wildlife
  - Habitat Disruption
  - Bird & Bat Kills: Collisions, Electrocutions
Noise

- Distinctly Audible
  They Are Not Silent
  They Will Be Heard

- Great Reductions in Noise

- But Noise is Constant--Ever-Present
  Except During Calms

- For Their Size, Small Turbines Noisiest
Birds & Bats

• Serious Problem
  
  Tarifa?
  
  Altamont Pass (150-300 Raptors/yr)

• A Concern Elsewhere

• No Quick Fixes--No Panaceas
  
  Stripes & Whistles Don’t Work

Paul Gipe & Assoc.
Birds & Bats

• Before & After Studies of Big Projects

• Studies Necessary for Small Projects?
Public Safety

- No Passerby Killed or Injured
- Ice Throw
  - Max. 100 m
  - 1.5 X Height
  - Post Warnings
- Blade Throw
- Suicides
  - Attractive Nuisance

Paul Gipe & Assoc.
Why Now?

• **Wind Works**
  Greater Reliability

• **Productivity Improved**
  More Efficient
  Taller Towers

• **Costs Declined**
  Economies-of-Scale
We Know What Works . . . and What Doesn’t
40 m, 500 kW

80 m, 1.8 MW

Northern Ireland

Kincardine, Ontario
Wind is Flexible

- **Scale**
  - Big or Small Projects
- **Location**
  - Near or Far
- **Time**
  - Short Lead Times
- **Ownership**
  - Local or Absentee
World Wind Capacity 2004
~46,000 MW

- Europe: 75%
- Asia: 9%
- North America: 15%
- Other Continents: 1%
2004 World Wind Capacity

7,200 MW

34,700 MW

4,100 MW
Wind Growing Rapidly

• Germany
  2,000 MW in 2004
  20,000 MW by 2006
  30,000 MW by 2012

• Spain
  2,100 MW in 2004

• France

• USA: 500-2,000 MW/yr

• Growth: 20%-40%/yr
## High Penetration is Possible

<table>
<thead>
<tr>
<th>Country</th>
<th>Percent Wind</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Netherlands</td>
<td>2%</td>
</tr>
<tr>
<td>Spain</td>
<td>6.5%</td>
</tr>
<tr>
<td>Germany</td>
<td>5.3%</td>
</tr>
<tr>
<td>Germany 2012</td>
<td>12.5%</td>
</tr>
<tr>
<td>Denmark</td>
<td>20%</td>
</tr>
<tr>
<td>Germany 2025</td>
<td>25%</td>
</tr>
</tbody>
</table>
Wind Energy is a Real Business
NZ$27 Billion in 2004
2004 Installed Wind Capacity Where New Zealand Stands

Megawatts (Thousands)

- Germany
- Spain
- USA
- Denmark
- California
- Texas
- New Zealand
Solar PV Growing Rapidly

- 2004: 2,300 MW Worldwide
- 750+ MW/yr
- NZ$8.5 Billion
- Major Markets
  - Germany--400 MW/yr
  - Japan--300 MW/yr
  - California--40 MW/yr
Solar PV in Germany

• 2004
  20,000 New Systems
  NZ$5 Billion
  Total of 110,000 Systems
  Total 740 MW
  4 X Wind in New Zealand!

• Costs Dropped 25%
  Since 1999
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 Wind Energy

Thy, Denmark
Distributed Wind Energy

Ostfriesland, Germany
Why the European Success?

- #1 Public Involvement
  Germany & Denmark
- #2 Advanced Renewable Tariffs
  16 EU Countries use Electricity Feed Laws
What is Community Power?

• Local
  Rooted in and Responsible to the Community

• Locally Owned
  Cooperative, First Nation, Farmer-Owned

• Commercial-Scale Generation

• Small Projects Making a Big Difference
Increasing Acceptance #1

“Your Own Pigs Don’t Stink”

Jutland, Denmark
Danish Co-ops
(Vindmølleaug or Fællesmølle)

- 1/4 Capacity Nationwide
- ~ $1.7CAD Billion
- 100,000 Households Own Shares
- 5% of Population
German Co-ops
(Bürgerbeteiligung)

- 1/3 Total Capacity
- ~$7CAD Billion
- 300,000 Own Shares
- 2/3 Schleswig-Holstein
- 4/5 Nordfriesland Amt

Hooksiel, Schleswig-Holstein, Germany
Sydthy Kabelaug Denmark

- 16 km of Buried Cable
- Direct to HV Network
- 26 x V27s (225 kW)
- ~1 Million kWh/unit
- Mostly Pig Farmers
Middelgrunden Co-op København

- 20 x 2 MW Off-shore
- 1/2 Owned by Co-op
- 1/2 Owned by Utility
- 8,500 Investors
- ~$1,000CAD per Share
- Visible from Folketing

©Bonus a/s
Toronto WindShare

- First Urban Turbine in N.A.
- Co-Owned
  WindShare Co-op
  Toronto Hydro
- Prominent Location
- Highly Visible
- Highly Popular
Elements of Success in Europe

- Right Price for Fixed Period
- Right of Interconnection
- By-Right Permitted Rural Use
Advanced Renewable Tariffs

• Creates Dynamic Markets
• Ensures Price Stability
• Encourages Manufacturing
• Offers Opportunity to Many Players
  - Farmers (New Cash Crop)
  - First Nations
  - Communities
  - Coops
  - Wind Companies
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?
## Renewable Energy Tariffs Status

<table>
<thead>
<tr>
<th>Existing</th>
<th>Regulations Pending</th>
<th>Proposed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>China</td>
<td>India</td>
</tr>
<tr>
<td>Brazil</td>
<td>Ireland</td>
<td>California (PV)</td>
</tr>
<tr>
<td>France</td>
<td>PEI, Canada</td>
<td>Italy (PV)</td>
</tr>
<tr>
<td>Germany</td>
<td>Washington State</td>
<td>Ontario</td>
</tr>
<tr>
<td>Greece</td>
<td>Turkey (Wind)</td>
<td></td>
</tr>
<tr>
<td>Portugal</td>
<td>Czech Republic</td>
<td></td>
</tr>
<tr>
<td>Spain</td>
<td>Minnesota C-BED</td>
<td></td>
</tr>
<tr>
<td>The Netherlands</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
# Wind Energy Tariffs

## European Job Creation Engine

<table>
<thead>
<tr>
<th>Europe</th>
<th>Direct</th>
<th>Indirect</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Germany</td>
<td>7,500</td>
<td>37,500</td>
<td>45,000</td>
</tr>
<tr>
<td>Denmark</td>
<td>8,600</td>
<td>4,300</td>
<td>13,000</td>
</tr>
<tr>
<td>Spain</td>
<td>7,000</td>
<td>15,000</td>
<td>22,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>80,000</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Enercon, Aurich, Germany
Germany’s Renewable Tariffs
The Results

- Renewables from EEG 9% of Supply
- Renewables Generating 40 TWh/yr
- 45,000 Employed in Wind Industry
- 15,000 Employed in PV Industry
- 135,000 Employed in Renewables
- 110,000 Jobs in Wind by 2010
Germany’s Renewable Tariffs
The Results

- 110,000 PV Installations
- 2,000 Biomass Plants
- 6,000 Hydro Plants
- 16,500 Wind Turbines
- Total of 135,000 Generators!

DeWind
EU External Costs of Generation

$\text{CAD/kWh}$

- **Oil**: 0.12
- **Coal**: 0.10
- **Natural Gas**: 0.04
- **Wind**: 0.00

EU financed international study: ExternE
Renewable Tariffs are About People--and Opportunity
Advanced Renewable Tariffs Are Equitable

- Feed Laws are Fair
- Nearly All Can Play
  Farmers, Ranchers, & Co-ops
## World Markets Develop

<table>
<thead>
<tr>
<th>Location</th>
<th>TWh/yr</th>
<th>MW</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>California</td>
<td>4.2</td>
<td>2,070</td>
<td>12,049</td>
</tr>
<tr>
<td>Denmark</td>
<td>6.8</td>
<td>3,105</td>
<td>5,590</td>
</tr>
<tr>
<td>Germany</td>
<td>25</td>
<td>16,629</td>
<td>16,543</td>
</tr>
<tr>
<td>Spain</td>
<td>12.2</td>
<td>8,263</td>
<td>10,225</td>
</tr>
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</table>
## New Zealand’s Renewable Target

### New Zealand Renewable Energy Target 2012

<table>
<thead>
<tr>
<th></th>
<th>PJ</th>
<th>TWh/yr</th>
</tr>
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<tbody>
<tr>
<td>Target</td>
<td>30</td>
<td>8.3</td>
</tr>
<tr>
<td>Total NZ Consumption</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>Percent Renewables</td>
<td>21%</td>
<td></td>
</tr>
</tbody>
</table>

### New Zealand Yields

<table>
<thead>
<tr>
<th></th>
<th>Low</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rotor Swept Area</td>
<td>1,000 kWh/m²/yr</td>
<td>1,500 kWh/m²/yr</td>
</tr>
<tr>
<td></td>
<td>8.3E+06 m²</td>
<td>5.6E+06 m²</td>
</tr>
</tbody>
</table>

### Turbine Details

<table>
<thead>
<tr>
<th>Turbine</th>
<th>Diameter (m)</th>
<th>MW</th>
<th>Swept Area (m²)</th>
<th>Units Low Yield</th>
<th>Units High Yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>36</td>
<td>0.5</td>
<td>1,000</td>
<td>8,300</td>
<td>5,600</td>
<td></td>
</tr>
<tr>
<td>62</td>
<td>1</td>
<td>3,000</td>
<td>2,800</td>
<td>1,900</td>
<td></td>
</tr>
<tr>
<td>80</td>
<td>2</td>
<td>5,000</td>
<td>1,700</td>
<td>1,100</td>
<td></td>
</tr>
</tbody>
</table>
Aesthetic Guidelines:
Design As If People Matter
Public Opinion Surveys

• “Beauty is in the Eye of the Beholder”
  True, But Most People Agree on “Beauty”
• Broad Support ~ 70%-90%
  On Both Sides of the Atlantic
• In the Abstract!
  Benefits Global
  Impacts Local
Aesthetic Design--Not New Idea

Poorly designed wind farms are often characterized by monotonous design, visual disorder, insensitivity to the land forms and poor erosion control. Careful planning can eliminate all of these problems.

CalPoly 1984
Provide Distinct Visual Units
Provide Visual Uniformity
Keep Them Clean

Use a Drip Pan or a Diaper (Nappie)
Bury All Intra-Project Lines
Minimize Roads

• Use Existing Roads
• Use Existing Tracks
• Minimize Width
• Minimize Radius
• Harden Where Needed
Eliminate Fencing
Sends the Wrong Message
. . . “Keep Out, Danger”
Inform Public
Simpler is Better
Provide Parking
Use White, Off-White, or Gray
Avoid Garish Patterns
Keep Sites Tidy
Pay Attention to Detail
Harmonize Structures
With Other Structures on Landscape

Buildings
No Billboards
No Logo!
Or Subtle Logo Only
In Sum . . . Be A Good Neighbor
Wind Energy is Compatible
With Most Existing Land Uses
... With Rural Residential
Yorkshire, England
With Commercial Uses

Westerwald, Germany

Lauwersoog, the Netherlands
Ebeltoft, Denmark

... With Harbours
With Row Crops
. . . With Grazing

Noordoost Polder, the Netherlands
. . . With Schools

Forest City, Iowa
... With Some Parks

Depending Upon the Level of Protection

Wellington (Brooklyn), NZ
... With Outdoor Recreation
With Cycling

Royd Moor, England

Westerwald, Germany
. . . With Walking & Jogging

Dunkerque, France
Tehachapi Pass, California

. . . With Hiking
Wind Turbines

. . . Sell Beer, Bier, Birra, Cerveza
Promote Community
& Pave the Way to the Future
Renewables:
When You Look Closely . . .
. . . Worth Every Cent
Renewable Energy
For Today and for Tomorrow
Technology for Life*

*from N.F.S. Grundtvig
Renewables Work!

www.wind-works.org