Small wind – a sustainable solution for rural electrification?
Climate Histories Seminar Series

Jon Sumanik-Leary
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CRASSH – Centre for Research in the Arts, Social Sciences and Humanities
University of Cambridge

Supervisors:
Dr Rob Howell (Mechanical Engineering)
Dr Aidan While (Town and Regional Planning)
Outline

- Small wind turbines for rural electrification
- Building theory from case studies
  - Peru, Nicaragua, Scotland, Inner Mongolia
- Multidisciplinary
  - Engineering → social science
  - Mixed methods
  - National, organisational & community
**Electrification**
- 1.4 billion without electricity
- 85% in rural areas

**Light**
- Kerosene lamps?

**Electricity generation**
- Grid extension?
- Diesel generators?
Wow! Aren’t wind turbines so great?!
Change of focus

CRASH!!!
Small Wind Turbines (SWTs)

- ‘Sustainability’
  - Major challenges:
    - Maintenance
    - Highly variable resource
Peru

- WindAid & Soluciones Prácticas
- Same context, different delivery models
Nicaragua

• **blueEnergy & AsoFenix**
• **Same turbine, similar delivery model, different context**
Scotland

- SWTs > 30 years
- Home of internationally renowned small wind expert, Hugh Piggott
Inner Mongolia (China)

Case study selection

Test case study: Inner Mongolia (China)
Case study I: Peru
Case study II: Nicaragua
Case study III: Scotland

No. turbines

Sustainability

Wind Aid
blueEnergy
Soluciones Practicas
Scoraig Wind Electric
blueEnergy & Asofenix
Maintenance

• SWTs have high maintenance requirements
  – Tools & spare parts
  – Technical knowledge
  – Capital
Tools, spare parts & technical knowledge
Tools, spare parts & technical knowledge
Tools, spare parts & technical knowledge
Maintenance: Peru
Maintenance: Peru

CRASSH Seminar Series  |  Jon Sumanik-Leary  |  jon.leary@sheffield.ac.uk  |  thewindyboy.wordpress.com
Maintenance: Peru

WindAID

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Maintenance: Peru
Maintenance: Peru

Service centre
Cajamarca

El Alumbre
(car/lechero) 2h
1h (car/lechero)

Alto Perú
1h (car/lechero)
(car/lechero) 2h

Campos Alegre
3h (car/lechero)

H.Q.
LIMA

(bus) 16h
Maintenance: Peru

SOLUCIONES PRÁCTICAS

WindAid
Maintenance: Nicaragua

<table>
<thead>
<tr>
<th>Location</th>
<th>2010</th>
<th>2011</th>
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<tbody>
<tr>
<td>Monkey Point</td>
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<td>Kahkabila Health Center</td>
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<td>Kahkabila School</td>
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<td>Pearl Lagoon</td>
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</tbody>
</table>
Maintenance: Nicaragua

![Graph showing maintenance status of solar panels in Nicaragua over time.](image-url)
Maintenance: Nicaragua
Maintenance: Nicaragua

- Tariff
- Consumables for preventative maintenance
- Spare parts for corrective maintenance
- Balance of maintenance fund

Graph showing costs and contributions for fuse, wind system, rotor & stator, dump load, charge controller, and solar system.
## Maintenance: Scotland

### Energy Systems
- Solar P.V.
- Wind
- Petrol generator
- Domestic electrical system

### Actions
- Repair
- Written off
- Upgrade
- Replacement

### Operating Status
- Red: Awaiting repair (not generating)
- Yellow: Awaiting repair (still generating)
- Green: Operating normally

![Diagram showing maintenance history and status](image-url)
Network of service centres
- Government sponsored
- Every county

Printed manuals

Most successful counties also trained community technicians

Maintenance: Inner Mongolia
Wind Resource
Wind Resource

• Highly variable resource
  – Space
  – Time

\[ P = \frac{1}{2} \rho AV^3 \]
Wind resource: Peru
Wind resource: Nicaragua

\[ P = \frac{1}{2} \rho AV^3 \]
Wind resource: Nicaragua
Wind resource: Nicaragua
Wind resource: Nicaragua

- Eligible municipalities
- 9,300 people
- No grid access
- Grid access
Wind resource
Scoraig: a case study in Scotland
Wind resource

• High temporal variation
Wind resource: PV-wind hybrids in Scotland

![Energy yield (kWh/month) graph]

- Piggott 3N
- PV

![PV Output graph]

![Piggott 3N Output graph]
Wind resource: global

Global Mean Wind Speed at 80m
Map 1. Share of people without electricity access for developing countries, 2008

Notes: Based on UNDP's classification of developing countries and the UNF's classification of LDCs. Some of the small countries and island states are not visible in the maps. For a complete list of countries, see Appendix 2. The designations employed and the presentation of material on this map do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations or UNDP concerning the legal status of any country, territory, city or area or its authorities, or concerning the delimitation of its frontiers or boundaries.
Conclusion

• Small wind has a role to play in rural electrification
  – Very niche technology. Potential limited by:
    • Resource availability
    • Social infrastructure
      – Maintenance services
      – Resource assessment
Conclusion

- People have a vital role to play in ensuring the sustainability of ‘sustainable’ energy technologies
  - Holistic, systems-level view
  - Every local context different
  - Establishment of social infrastructure
  - Long term support for new technologies
Questions?

Thanks for listening!

www.thewindyboy.wordpress.com
References.

- HDI vs kWh map:
- Global wind, solar and hydro maps:
  - © 3Tier
- Peru community training photo:
- Peru volunteer turbine photo:
  - Courtesy of James Low
- Nicaragua cracked turbine photo:
- 1950 Scoraig photo:
  - Courtesy of Scoraig.com
- All Inner Mongolia images:
- Car and bicycle repair images:
  - Google images
- Peru topographical map:
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• Lightning map:

• Nicaragua wind map:

• Nicaragua wind turbine construction workshop:

• Peru and Cajamarca wind maps:

• El Alumbre wind map:

• Nicaragua solar map:

• UK and Scoraig map:

• El Alumbre seasonal variation plot:

• Access to electricity map: