Role of patents in renewable energy technology innovation

Presentation to IRENA Roundtable on Assessment of IPRs for Promoting Renewable Energy

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Our research has been covered by the Harvard Business Review, Financial Times, Bloomberg, Nature and other leading media.
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Outline

• Patent-based intelligence for technology companies
• Case study: Desalination and Renewables
• Case study: Wave & Tidal energy
• Conclusions
Patents: What are your opinions?

Are patents “good” or “bad”?

• Patents as enablers
  • Information provision
  • Technology transfer
  • Standards & Licensing

• Patents as barriers
  • Legalistic
  • Inherently monopolistic
  • Favoring larger players
How do IPRs relate to real world products?

A modern and complex technology product is protected by different forms of IPRs

**Patents**: ability to prevent others from using your technology
- e.g. patents around turbine transmission systems

**Trade Secrets**: non-disclosed and commercially valuable information
- e.g. production or installation methods

**Trade Mark**: protection of the word/symbol denoting the origin of a good

**Copyright**: protecting the form of expression
- e.g. Control software written by/on behalf of Suzlon

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How do IPRs relate to real world products? 2

Value in a modern technology product may be secured by different types of Intellectual Property (IP)

**Patents:** ability to prevent others from using your technology
- e.g. Touch screen technology

**Trade Secrets:** non-disclosed and commercially valuable information
- e.g. mobile ‘wallet’ technology (Google – PayPal litigation, 2011)

**Trade Mark:** protection of the word/symbol denoting the origin of a good
- e.g. Galaxy®, iPhone®

**Copyright:** protecting the form of expression
- e.g. Software applications
Patents: A wealth of technical knowledge

The patent system represents a significant global technological library

- Patents as data are:
  - Structured
  - Comparable
  - Objective
  - Information rich

- Multiple patent data sources are available (an opportunity and a challenge!), e.g:
  - Free: USPTO, EPO’s Espace.net, Google Patents
  - Paid:
    - CambridgeIP’s BolivenPro (get your free trial!!!)
    - Thomson Reuters
    - Lexis Nexis
Each component of a device may be patented

- **Material science**
  - Nokia
    - Graphene - resonator patent

- **Physical processing**
  - Qualcomm
    - CDMA patents filed after 1999 claim implementation through software instructions

- **Data processing**
  - Nortel
    - Patent portfolio sold for $4.5 billion

- **Presentation**
  - Facebook
    - Various US design patents

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Patents... There’s lots of them!

Patents can be a highly reliable source of information about an industry

- Patents as data are structured, comparable, objective and information rich
- Information on technology, inventors, linkages to other fields…

But… there’s many of them!

A simple search for ‘wireless communication’ returns 850,050 patents!
Where do you begin?
Patents... There's lots of them! Part 2
If a market is important – there will be many patents

In Wind Energy and Solar PV technology the rate of patent applications accelerated as the market value increased

It is of interest to understand the extent to which the value chain is ‘owned’ or controlled by the top organisations overall: are there areas where new entrants are making an impact?

### Wind - Overall space

- Enercon
- General Electric
- Vestas Wind System
- Mitsubishi
- LM Glasfibre

### Gearbox

- General Electric
- Vestas Wind System
- Enercon
- Mitsubishi
- NTN
- Hansen Transmission

### Generator

- Enercon
- General Electric
- Mitsubishi
- Hitachi
- Vestas Wind Systems

### Blade/wings

- Enercon
- General Electric
- Vestas Wind Systems
- LM Glasfibre
- Mitsubishi

### Energy Storage

- General Electric
- ABB
- VRB Power Systems
- Hitachi
- Canon

### Software/Control Systems

- General Electric
- ABB
- Vestas Wind Systems
- Siemens
- Repower Systems

And how are IPRs used in practice?

The IPR mechanism/arrangement used at each part of the technology innovation chain can determine next stage options for technology transfer/diffusion. The full range of stakeholders have an influence on how IPRs are used, from investors to competitors to governments.

Multiple business models and ways of using IPRs, depending on industry history, economics, inherited business models, norms, etc.
<table>
<thead>
<tr>
<th>Technology ideation</th>
<th>Feasibility Study</th>
<th>Develop</th>
<th>Evaluate</th>
<th>Market Release</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technology concept formulated</td>
<td>Proof-of-concept validated</td>
<td>System prototype</td>
<td>System completed and tested</td>
<td>Marketing</td>
</tr>
</tbody>
</table>

- Technology ideation
- White Space
- Investor due diligence
- FTO analysis
- Competitor monitoring
- Collaboration opportunities
- Licensing in/out
- Infringement monitoring
- IP portfolio quality
- M&A strategy
- Identify new markets
• Patent-based intelligence for technology companies
• Case study: Desalination and Renewables
• Case study: Wave & Tidal energy
• Conclusions
“Continued improvement in efficiency and decreasing costs of desalination systems – in combination with dropping costs of some renewable energy technologies – holds the promise of larger scale integration of desalination with renewable energy is driven by”
Innovation around desalination has accelerated rapidly – leading to increased diversity of desalination technology types on the market or in R&D.

Desalination technologies

- Membrane processes
  - Reverse osmosis
  - Forward osmosis
  - Electrically driven

- Thermal processes
  - Multistage flash
  - Distillation
  - Multi-effect distillation
  - Vapour compression
    - Thermal
    - Mechanical

- Chemical and other processes
  - Membrane distillation
  - Electrodeionisation
  - Capacitive deionisation
  - Freeze separation
  - Vacuum distillation
  - Gas hydrated
  - Ion exchange
  - Adsorption
  - Saline concentration difference

Source: CambridgeIP 2012
Key innovation drivers for desalination technologies

- Energy cost reduction
- Component cost reduction
- Managing brine impact on local ecosystems
- Managing Co2 impact (especially for large urban systems)
- Centralised vs. decentralised water systems
  - Emerging markets and off-grid – need for decentralised modular units
  - Major urban areas – need for large scale high-efficiency desalination plants
- Location specific challenges, e.g. Local pollutants, feed water quality
Patent search strategy

The diagram illustrates search strategy components

- Desalination terms were used together with:
  - Desalination technology descriptors (blue)
  - renewable energy technology descriptors (red)
  - relevant IPC codes (purple)

- Boundaries between categories are not clear-cut

- There are data overlaps between all the categories

- Most of these categories also include patents outside of the desalination space
Lists of search terms have been developed for each of these categories

**Type** | **Code** | **Description**
--- | --- | ---
IPC | C02F 103/08 | Seawater, e.g. for desalination
IPC | C02F 1/* | Treatment of water, waste water, or sewage
IPC | C02F 9/* | Multistep treatment of water, waste water or sewage
IPC | B63J 1/00 | Arrangements of installations for producing fresh water, e.g. by evaporation and condensation of sea water
ECLA | C02F 1/* | Treatment of water, waste water, sewage or sludge
USCC | 210* | Liquid purification or separation
• There has been an acceleration broadly in innovation in desalination technologies
  • Within that context, since the 2000’s we have seen an acceleration of desalination – renewables integration innovations – in particular around Solar PV
Japanese companies are the main patent holders... but there has been a drop in the patenting activities of Japanese companies, especially clear in the last 5 years.

New major entrants in the last 5 years of patenting are General Electric, Doosan and Siemens...

...and many small high-tech companies

<table>
<thead>
<tr>
<th>Top assignees – all time</th>
<th>Nr of families</th>
</tr>
</thead>
<tbody>
<tr>
<td>MITSUBISHI HEAVY INDUSTRIES LTD</td>
<td>119</td>
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<tr>
<td>HITACHI LTD</td>
<td>118</td>
</tr>
<tr>
<td>JAPAN ORGANO CO LTD</td>
<td>99</td>
</tr>
<tr>
<td>KURITA WATER IND LTD</td>
<td>88</td>
</tr>
<tr>
<td>EBARA CORP</td>
<td>74</td>
</tr>
<tr>
<td>TOSHIBA CORP</td>
<td>48</td>
</tr>
<tr>
<td>TORAY INDUSTRIES INC</td>
<td>42</td>
</tr>
<tr>
<td>HITACHI ZOSEN CORP</td>
<td>36</td>
</tr>
<tr>
<td>CHEN MING</td>
<td>33</td>
</tr>
<tr>
<td>ISHIKAWAJIMA HARIMA HEAVY IND CO LTD</td>
<td>31</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Top assignees – last 5 years</th>
<th>Nr of families</th>
</tr>
</thead>
<tbody>
<tr>
<td>GENERAL ELECTRIC COMPANY</td>
<td>21</td>
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<tr>
<td>LEE SANG HA</td>
<td>15</td>
</tr>
<tr>
<td>SUH HEE DONG</td>
<td>14</td>
</tr>
<tr>
<td>KURITA WATER IND LTD</td>
<td>12</td>
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<tr>
<td>MITSUBISHI HEAVY INDUSTRIES LTD</td>
<td>10</td>
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<tr>
<td>DOOSAN</td>
<td>8</td>
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<tr>
<td>SIEMANS AG</td>
<td>8</td>
</tr>
<tr>
<td>UNIVERSITY TIANJIN</td>
<td>8</td>
</tr>
<tr>
<td>JAPAN ORGANO CO LTD</td>
<td>7</td>
</tr>
<tr>
<td>KOBELCO ECO-SOLUTIONS CO LTD</td>
<td>7</td>
</tr>
</tbody>
</table>
Low Temperature Thermal Desalination: Water runs down a plastic sheet, hot carrier gas travels over the water capturing the clean water vapour. The Process recaptures energy from evaporation/condensation 3 times, making it 3 times more efficient than standard thermal distillation techniques.

Renewable Energy: Solar and waste heat

<table>
<thead>
<tr>
<th>Patents</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Key Inventors</td>
<td>BRUFF MATTHEW JASON; GODSHALL NED ALLEN</td>
</tr>
<tr>
<td>Co-Assignees</td>
<td>None</td>
</tr>
<tr>
<td>Earliest patent application</td>
<td>2007</td>
</tr>
<tr>
<td>Priority countries:</td>
<td>US only</td>
</tr>
</tbody>
</table>
Abstract: A buoyant actuator (10) for use in apparatus (11) for harnessing wave energy in a body of water such as the ocean. The buoyant actuator (10) is deployed within the body of water (12) and is responsive to wave motion in the body of water. The buoyant actuator (10) comprises a body (101) incorporating a flow path along which water can flow, and a gate means (115) for controlling flow along the flow path. The gate means (115) comprising a plurality of closure elements configured as flaps (221) providing a barrier (222) across the flow path through the body (101). Each flap (221) is moveable into and out of a condition in which it cooperates with the other flaps (221) to provide the barrier (222). A latch mechanism (231) is provided for releasably retaining each flap (221) in the condition providing the barrier (222). The latch mechanism (231) comprises a magnetic coupling.
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The diagram below summarizes the IP landscape patent dataset focus areas.
It is interesting in the wave and tidal technology space to observe significant patenting activity prior to 1980. A key early invention was of “Salter’s Duck” in Edinburgh in the 1970’s and an interest in renewable energy sources during the oil crises in the 1970’s.
Top assignees in the wave & tidal space

Ocean Power Technologies is seen to dominate the other players by number of patents and patent applications.

UK companies have a strong presence in this wave and tidal energy space, where Sweden also seems to be playing a leading role.

<table>
<thead>
<tr>
<th>Company</th>
<th>Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>OCEAN POWER TECHNOLOGIES</td>
<td>USA</td>
</tr>
<tr>
<td>MITSUBISHI</td>
<td>Japan</td>
</tr>
<tr>
<td>HITACHI</td>
<td>Japan</td>
</tr>
<tr>
<td>WAVEBOB</td>
<td>Ireland</td>
</tr>
<tr>
<td>SWEDISH SEABASED ENERGY</td>
<td>Sweden</td>
</tr>
<tr>
<td>IPS INTERPROJECT SERVICE</td>
<td>UK</td>
</tr>
<tr>
<td>INDEPENDENT NATURAL RESOURCES</td>
<td>USA</td>
</tr>
<tr>
<td>APPLIED RES &amp; TECH</td>
<td></td>
</tr>
<tr>
<td>UK SECRETARY OF STATE FOR ENERGY</td>
<td>UK</td>
</tr>
<tr>
<td>SEAPower PACIFIC</td>
<td>Sweden</td>
</tr>
<tr>
<td>WAVE STAR ENERGY</td>
<td>Denmark</td>
</tr>
<tr>
<td>SINGLE BUOY MOORINGS</td>
<td>Netherlands</td>
</tr>
<tr>
<td>SEA ENERGY ASSOCIATES</td>
<td>UK</td>
</tr>
<tr>
<td>MITSUI</td>
<td>Japan</td>
</tr>
<tr>
<td>SEABASED</td>
<td>Sweden</td>
</tr>
<tr>
<td>VOITH TURBO</td>
<td>Germany</td>
</tr>
<tr>
<td>HYDROVENTURI</td>
<td>UK</td>
</tr>
<tr>
<td>BIOPower SYSTEMS</td>
<td>Australia</td>
</tr>
<tr>
<td>FUJI ELECTRI</td>
<td>Japan</td>
</tr>
<tr>
<td>FOBOX</td>
<td>Norway</td>
</tr>
<tr>
<td>TRIDENT ENERGY</td>
<td>UK</td>
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  - Legalistic
  - Inherently monopolistic
  - Favoring larger players
Patent-based intelligence provides fact-based support for decision making

• IP Strategy
  • How is IP used in different industry spaces?
  • What IP strategies are open to a country’s industrial players?
  • Do they have ‘White Space’ and ‘Freedom to Operate’?

• Business Strategy
  • What are the emerging technologies? What patents underpin these?
  • Who are the key players?
  • What are key industrial partners working on?
  • Who else has ‘done it’ in a space?
  • How complex is a space? Is it speeding up or slowing down?
Please get in contact with either Ilian or Helena to discuss how CambridgeIP can help to develop an IP business strategy for your specific technology intelligence requirements.

Take up a free 14 days’ trial of BolivenPRO, CambridgeIP’s collaborative patent search platform

Thank you!

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