Agenda

• RE-INDUSTRY study

• Case studies summary

• Main issues for integration of RE on industrial sites

• Focus on three public policy recommendations

• Conclusion
Context and objectives of the study

Context

• Industry can and has to play an important role in the energy transition through integrating renewable energy (RE) production assets at their sites

Objectives

• Provide inspiration and state-of-the-art applications of RE in industry
• Present best practices and key developments of RE in the industry: existing and emerging technologies, drivers, barriers, policies and lessons learned
• Formulate policy recommendations to foster RE integration in industry

Study Authors
Methodology of the study

1. 200+ project database
2. Selection of 21 projects for case studies
3. Policy recommendations towards policy makers
4. Communication plan

Selection criteria
- “Inspiration” level
- Industry & geography representativeness
- Project category
- Data availability

Sources
- Lessons learned from the 21 projects
- Bibliographical review
- IEA-RETD REX
Selection of the 21 case studies
The 21 case studies were selected to represent most of the geographical areas, industrial sectors and RE technologies.
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Synthesis of case studies

RE projects are driven by different motivations

• Developed vs. Developing countries
  • All of the projects in developing countries are motivated by profitability concerns
  • In developed countries, RE is also seen as a way to reduce the exposure to energy price uncertainty

• On-grid vs. Off-grid industrial sites
  • Off-grid: RE integration is an opportunity to reduce fossil fuel reliance
  • On-grid: Ensure energy supply in countries with unreliable grid and opportunity to sell surplus of power

• B2C vs. B2B industries
  • RE projects are often driven by corporate image and long term sustainability in B2C industries
  • B2B companies are mostly driven by operational benefits and productivity increase
Integration of RE on industrial assets brings direct benefits to industrial players

- **Reduced energy cost** and prices hedging from future increases of fuel and grid prices

- **Improved energy reliability**

- **Increased productivity**

- **Additional revenue-generating opportunities**

- **Greater coherence with corporate commitments** on environmental and local development

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**Synthesis of case studies**

- €5.3 million annual savings from road-transported fuel consumption reduction

- CHP from grape waste to have a more grid-independent and stable power supply

- Productivity increased by 5% after its 27 MW<sub>th</sub> geothermal project

- Surplus of solar power is sold to the grid at retail price (net-metering)

- Beyond economic profitability, biomass project is a waste recovering solution for communities
Different levels of RE integration are possible

- **Green power procurement** with a third party power producer on the premises of the industrial asset
- **On-site installation of fully owned** and operated RE generation assets
- **On-site installation of RE production assets** and process adaptation
- **Paradigm shift**: Renewable raw materials, energy, and by-products valorization
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Overview of the 8 main issues identified

1. Energy production regulatory regime
2. Investment
3. Return on investment
4. Technology maturity
5. Operability and integration
6. Risk mitigation and insurance mechanisms
7. Contractual schemes complexity
8. Awareness
Main issues for integration of RE on industrial sites

Energy production regulatory regime

<table>
<thead>
<tr>
<th>Issues</th>
<th>Lessons learned</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Free production of energy by independent players</td>
<td>• Adapt solution to the size of the company</td>
</tr>
<tr>
<td>• Right to valorize the energy produced</td>
<td>• Contract with a third party power producer</td>
</tr>
<tr>
<td></td>
<td>• Enhance the value of heat production through self-consumption</td>
</tr>
<tr>
<td></td>
<td>• Think dynamically when sizing the project</td>
</tr>
</tbody>
</table>

Policy implementation

| • Allow for third-party energy production and valorization             | Investment in a CHP and not a biomass boiler in order to sell extra power to the grid (extra revenue) |
| • Develop standard interconnection contract terms for industrial prosumers | It mainly produces heat during the harvest season and electricity during the rest of the time |
| • Guarantee the stability of payments for energy exported to the grid  |                                                     |
| • Provide guidelines and regulatory framework for heat trading        |                                                     |

CHP from bagasse at a sugar mill (Thailand)

73 MW, 710 tons/hour of steam

Credit: Cogen3
Main issues for integration of RE on industrial sites

2. Investment

<table>
<thead>
<tr>
<th>Issues</th>
<th>Lessons learned</th>
</tr>
</thead>
<tbody>
<tr>
<td>• RE projects usually require higher up-front investment costs than traditional fossil fuel generation units</td>
<td>• Transfer the investment to a third party power producer</td>
</tr>
<tr>
<td>• Financing availability</td>
<td>• Share the risks and investment through an SPV</td>
</tr>
<tr>
<td>• Capital lockup</td>
<td>• Search for alternative funding schemes</td>
</tr>
</tbody>
</table>

Policy implementation

• Provide investment support mechanisms: direct subsidies and loans, subsidized loans, investment tax credits, direct production incentives
• Enable third party power purchase through third party power producers

Solar flat-plate collectors to produce hot water for copper mining process (Chile)

PPA to externalize investment to third party and to secure long-term stable energy prices (crucial issue for energy intensive activities in off-grid areas)
# Return on investment

## Issues

- RE projects often come with long payback times and lower return on investment compared to the core activity of the industrial company.
- Each industrial sector has defined payback time target according to their market cycles.

## Lessons learned

- Investment to a third party power producer
- Share the risks/investment through an SPV
- Oversize the installation
- Enhance the value of various by-products
- Enhance heat and power synergies and EE

## Policy implementation

- Allow accelerated depreciation of RE assets
- Value the environmental benefits of RE and remove hidden subsidies on fossil fuels
- Provide advantageous rates for the purchase of decentralized RE
- Provide guidelines and regulatory framework for valorization of by-products

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**Tri-generation from bio-methanation at fruit and vegetable processing plant (India)**

1.67 MW, 1,200 kg/h steam

Bio-methanation transforms waste disposal expense into valorization opportunities: electricity/heat generation and sales, and digester slurry sales as marketable soil conditioner.

www.iea-retd.org
## Technology maturity

### Issues

- Contrary to mature RE technologies (like solar, wind, geothermal and biomass), some still require developments (power-to-gas, tri-generation) or renewable heat integration for various industrial process.
- Additional costs of non-mature technologies

### Lessons learned

- Participate in industry-wide research and development programs

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**Electrolysis process powered by solar/wind power generates $H_2$ for forklifts and trucks (Belgium)**

**Solar PV:** 800 kW<sub>e</sub>  
**Wind turbine:** 1.5 MW<sub>e</sub>  
**Fuel cell:** 120 kW<sub>e</sub>

Credits: Colruyt

Part of the European INTERREG IV project implemented in Belgium by the Hydrogen Region Flanders/South Netherlands’s initiative which aims to become a leading player in the development of the hydrogen economy

€1 million grant from Government and INTERREG IV
Main issues for integration of RE on industrial sites

5 Operability and integration

### Issues

- Adequate skills and expertise
- Difficult integration within the industrial processes
- Difficult integration in the factory and its surroundings
- Integration with the electrical grid

### Lessons learned for industrials

- Plan the renewable asset accounting for synergies between the process and energy streams
- Anticipate and adapt the integration to the factory and its environment
- Use the services of external specialists

### Policies implementations

- Create a RE integration in industrial processes pole of excellence at local level
- Support non industrial actors like technology developers and operators
- Prepare for the integration of such projects to the grid

### World first carbon neutral brewery – Göss factory (Austria)

*HEINEKEN*

**Hydro:** 1.3 MW<sub>el</sub>
**CHP:** 0.45 MW<sub>el</sub> / 0.47 MW<sub>th</sub>
**Solar thermal:** 1.1 MW<sub>th</sub>

Credits: Brau Union Österreich

The mashing process had been adapted, switching the energy input from steam to hot water, to integrate the solar thermal plant into the core processes of the brewery.
### Main issues for integration of RE on industrial sites

#### Risk and insurance

<table>
<thead>
<tr>
<th>Issues</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Continuity of energy supply</td>
</tr>
<tr>
<td>• Reliability of fuel supply and protection from prices fluctuation</td>
</tr>
<tr>
<td>• Physical safety of industrial asset</td>
</tr>
<tr>
<td>• Livability of the off taker</td>
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</tbody>
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<table>
<thead>
<tr>
<th>Lessons learned</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Think in terms of interactions between heat and power</td>
</tr>
<tr>
<td>• Look for technical and contractual backup to ensure continuous power supply</td>
</tr>
<tr>
<td>• Make the industrial asset part of a diversification strategy</td>
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</table>

**Policy implementation**

| • Guarantee access to grid for back-up                               |
| • Offer guarantees for renewable power in the industry projects      |
| • Enable local smart grids                                          |

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*Process hot water from solar evacuated tube collectors at a textile plant (China)*

Jiangsu Changshu Jinhong Printing & Dying

**Solar:** 6.3 MW<sub>th</sub>

Solar ETC used to pre-heat a hot water storage at 60° before taking the water to 90° with a coal boiler.

Reduction of coal use without putting the operations at risk. In processes involving both heat and power, one can take precedence over the other in case of failure.
# Contractual schemes complexity

## Issues

- Contractual complexity can prevent industrials to turn thought into direct implementation
- Complexity of Power Purchase Agreements
- different timeframes between third party power producers (15-20 years) and industrial companies (market cycles)
- Complexity of participation in the retail or wholesale electricity market

## Lessons learned

- Contract with specialized energy management companies for participation in the retail/wholesale electricity market
- Develop new offers to reconcile third party power producers’ lifetime requirements and industrial players’ market cycles
- Experiment blockchain transactions

## Policy implementation

- Support the creation of simple and accurate contractual schemes

## Example of an innovative contractual scheme

The UK-based project developer Lightsource RE has developed more flexible approach to the mining industry than third party power producers’ traditional 20-year offers.

The company offers 5 to 10-year contracts; at the end the client can renew it or Lightsource RE brings the solar installation somewhere else.
# Main issues for integration of RE on industrial sites

## Awareness

**Issues**

- Knowledge of costs and benefits
- Availability of information
- Knowledge of operational best practices
- Knowledge of support mechanisms
- Inspiration

**Lessons learned**

- Engage in inter-professional associations and sector-specific associations to share information
- Positively communicate on success and failure stories

### Policy implementation

- Compile information and make it easily available for industrial actors and OEMs
- Promote information sharing between stakeholders and facilitate dialog
- Build a comprehensive framework for the integration of RE in the industry and support the development of an external advising offer

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4 MW biomass from wood fired steam boiler for Brewery Vestfyen (Denmark)

Besides a grant, the Danish Energy Agency provided informative services (publications, maps and analyses)
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Focus on three public policies recommendations

Provide guarantees to reduce investment risks

**Issues**
- Risks, technology maturity issues and lack of knowledge from investors
- Direct subsidies reduction in the current context of public budget cutbacks

**Policy implementation**
- Opportunity for policy makers to shift from direct public funding to private financial support
- Government or independent banks can offer guarantees on loans contracted with private commercial banks through a dedicated guarantee fund

**Targeted beneficiaries**
- Industrial project developers
- Commercial banks
- Public finances

**Expected impacts**
- Remove external funding barriers
- Help project developers finance RE assets at lower cost by minimizing risks and interest rates

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**Wood biomass boiler and deep geothermal source steam plant at starch factory (France)**

**Biomass boiler:** 43 MW<sub>th</sub>
**Deep geothermal:** 24 MW<sub>th</sub>

€13 million from “Guarantee Fund Geodeep” partly financed by ADEME, aims at providing guarantees against risks of insufficient geothermal resource. It is thus a genuine aid to the commitment of investment by reducing the risk borne by the project.

www.iea-retd.org
Focus on three public policies recommendations

Allow third party power production to reduce pay-back time and operational implementation

**Issues**
- Industrial players are willing to transfer ownership of their RE projects to third party power producers to reduce investment, simplify project implementation and remove auxiliary assets from their balance sheets
- In some countries, industrial players can only buy power from the State’s utility or self-consume

**Policy implementation**
- Allow third party producers and facilitate third party producers activities
- Prepare model contracts to be used by industrial actors willing to contract with a third party producer

**Targeted beneficiaries**
- Industrial actors with limited investment capacities or willing to deconsolidate their investments
- Third party power producers

**Expected impacts**
- Industrial players can transform CAPEX into OPEX and reduce payback time, making them more willing to integrate RE
- Secure long-term energy prices

**Hydrogen fuel cell and solar PV at a food processing plant (US)**

Solar PV: 1 MW<sub>e</sub>  
Fuel cells: 2.6 MW<sub>e</sub>

15-year flat rate Power Purchase Agreement with BNB Renewables to purchase 100% of the solar PV plant production at competitive rates with the retail electricity market

Credits: Pepperidge Farm
Focus on three public policies recommendations

Implement localized policy demonstration projects and clusters to test ideal regulatory solutions

Issues
- Policy makers are eager to see the development of new technologies and expertise in their territories but do not wish to adopt measures that could have important impacts on the grid and their revenues from taxes.

Policy implementation
- Create a unique administrative desk for permitting, financing and advising
- Test different types of policies/support mechanism and practices in the experimental eco-park
- Experiment promising technologies and use the eco-park as a showcase

Targeted beneficiaries
- All stakeholders involved in a project of RE integration
- Policy makers

Expected impacts
- By providing implementation feedback, policy makers can have a clear idea of the extent of those risks and thus continue to hinder the development of new energy production schemes
- Foster the development of disruptive technologies and ideas
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Conclusion

• The integration of RE production assets in the industry is already a real dynamic across diverse industrial sectors worldwide.

• Nevertheless, public support and technical, contractual and business innovation are still required to make RE integration a widespread practice in the industry globally.

• Policy makers should ensure that regulation allows and even fosters different RE integration schemes.

• Industrial actors should accelerate their commitment to adapt their financial and contractual engineering to such schemes.

• If those barriers are lifted there is a large room to generate many new and successful projects in the coming years.
For additional information on RETD

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Contact:  [info@iea-retd.org](mailto:info@iea-retd.org)