A short-term rental E-Bike system for city/island transportation

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Université de Mons

UMONS Research Institute for Energy/NZED Unit
Environmental & . . . Economic Pain

For every 800 km an electric bike is used in place of a car, an average of 94 litres of fuel is saved.

For every 800 km an electric bike is used in place of a car, this much pollution is prevented:
- 1.55 kg of hydrocarbons,
- 11.46 kg of carbon monoxide, and
- 0.77 kg of nitrogen oxides.

Avoiding just 10 km of driving every week would eliminate 500 kg of carbon dioxide emissions a year.

Electric bikes can generally cover 32 to 80 km on a battery charge, well within the distance of many daily commutes.
International tourist arrivals in Greece during 2014 were 23 millions (↑15% compared to 2013 and even more in 2017); a significant amount of these tourists are interested in cycling.

Greece has many touristic places ideal for cycling.

However, the majority of the hotels in those places do not provide to their clients bicycles... (and even more e-bikes!)
Problem (Physical Pain)

With conventional bikes, the rider gets...

- Sweat
- Discomfort
- Tiredness
e-bikes use helps to prevent cardiovascular diseases, hypertension, diabetes type II and colon cancer. As a result, e-Bikes use helps to reduce the general cost of the health system (Cantoreggi Nicola, Diallo Thierno, 2006).

e-bikes provide a fun, practical option for people to incorporate active travel into their most frequent trips. Mode shift from car trips suggest that e-bikes increase regular (weekly, daily) physical activity (Journal of Transport & Health 2, 2015, 276-283).

‘Life is like riding a bicycle. To keep your balance you must keep moving’ (Albert Einstein, letter to his son Eduard, 1930).
The Hook

40 million e-bikes globally (market size) with a growth rate from 2006-2013 of 19%-65%!!

(2009 – 200,000 e-bikes sold, 2005 – 100,000 e-bikes sold)
The concept

e-Bike-Inn is an automated online service for short-term rental of e-bikes aiming at serving the transport needs of tourists, in particular those staying at a hotel, B&B, etc.
The service

Explore your tourist destination from the seat of an e-bike with 5 simple steps!

Register  Reserve  Pick up  Ride  Return
# The competition

<table>
<thead>
<tr>
<th>Competitor</th>
<th>Location</th>
<th>e-bike rental</th>
<th>Online reservation</th>
<th>Short-term rental duration</th>
<th>Flexible pricing</th>
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</thead>
<tbody>
<tr>
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<td>Several locations in Greece</td>
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<td>×</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td>#2</td>
<td>Several locations in Greece</td>
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<td>×</td>
<td>✓</td>
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<tr>
<td>#3</td>
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<td>Milos (n/a at present)</td>
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<td>✓</td>
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<td>#6</td>
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<td>#7</td>
<td>Athens</td>
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<td>✓</td>
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<td>#8</td>
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<tr>
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<td>Athens</td>
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<td>✓</td>
<td>×</td>
<td>×</td>
</tr>
</tbody>
</table>

**e-bike-Inn**

Touristic places with hotels / agrotourism (Chalkidiki, Mykonos, Santorini, Crete)

<table>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
Objective:
Size the PV installation on an e-bike charging station under various case scenario using HOMER software on a pre-defined number of e-bikes.
Load profile: 10 e-bikes charging schedule for 1 year = 8,760 entries for each hour

1.44kW peak hour value, average 3.52 kWh/day

Solar global horizontal irradiance and temperature data acquired for locations in Greece and Belgium

Principal assumption: The charging demand of each e-bike is passed to an hourly total charging demand which is introduced to the model as a variable electric load.
## Case 1: Belgium Standalone vs Grid connected

<table>
<thead>
<tr>
<th>Lifetime (years)</th>
<th>PV (kW)</th>
<th>Storage (Units)</th>
<th>Converter (kW)</th>
<th>COE (€)</th>
<th>NPC(€)</th>
<th>Initial Capital(€)</th>
<th>Operating Cost (€)</th>
<th>Renewable Fraction(%)</th>
<th>Production per year (kWh)</th>
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</thead>
<tbody>
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<td>100</td>
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<td>13,000</td>
<td>-737.97</td>
<td>100</td>
<td>2,802</td>
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</tbody>
</table>

**Total PV area required:** 15 panels with a total area of 24.3806 m²

*In standalone design a converter is not required as DC is the only type of electric load handled*

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<th>Converter (kW)</th>
<th>COE (€)</th>
<th>NPC(€)</th>
<th>Initial Capital(€)</th>
<th>Operating Cost (€)</th>
<th>Renewable Fraction(%)</th>
<th>Energy Purchased per year (kWh)</th>
<th>Energy Sold per year(kWh)</th>
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<tbody>
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<td>1,205</td>
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<tr>
<td>10</td>
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<td>0</td>
<td>1.58</td>
<td>0.103</td>
<td>2,172</td>
<td>2,475</td>
<td>-40.95</td>
<td>58</td>
<td>1,205</td>
<td>1,557</td>
</tr>
</tbody>
</table>

**Total PV area required:** 6 panels with a total area of 9.752239 m²

Price of grid electricity 0,100 €/kWh for Belgium
### Case 3: Greece Standalone vs Grid Connected

<table>
<thead>
<tr>
<th>Architecture</th>
<th>Cost</th>
<th>System</th>
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</thead>
<tbody>
<tr>
<td>Lifetime (years)</td>
<td>PV (kW)</td>
<td>Storage</td>
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<td>1</td>
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<tr>
<td>10</td>
<td>3.0</td>
<td>1</td>
</tr>
</tbody>
</table>

Total PV area required: **9 panels with total area 14.62836 m²**

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<th>System</th>
<th>Grid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lifetime (years)</td>
<td>PV (kW)</td>
<td>Storage</td>
<td>Converter (kW)</td>
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<tr>
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</tr>
<tr>
<td>10</td>
<td>1.0</td>
<td>0</td>
<td>1.58</td>
</tr>
</tbody>
</table>

Total PV area required: **3 panels with total area of 4.876119 m²**

Price of grid electricity 0.150 €/kWh for Greece
Why e-bike-Inn?

It is for **everyone**!

It is **fast**!

It is **economic**!

It is **practical and comfortable**!

It is **ecological**!
Charge your holidays with our e-bikes!
Ride fast! Travel ecologically! Go further!


Present NZED Research Unit

Research Unit at RIE/UMONS (2014-Present):
Net-Zero Energy Efficiency on City/Districts (NZED)

Prof. Ioakeimidis

ERA-Chair Holder

Dr. Kostas 2017-Pre

Sesil 2015-Pre

Ali 2015-Pre

Dimitris 2015-Pre

Fivos 2016-Pre

Pawel 2015-Pre

Dr. Luis 2016-Pre

Dr. Nicolas 2014-Pre

Dr. Ludovic 2014-Pre

Dr. Barbara 2014-Pre

Julien 2017-Pre

Senior Researchers (PT)

Senior Researcher (FT)

PhD Researchers

Communication/Business Development (PT)
Thank you for your time!

Questions & discussion

You can find us at:
http://www.pgbike.herokuapp.com