Salinity Gradient Power in Europe: State of the Art

Sustainable Energy Week Brussels
NETHER house, 13 April 2011

Institute for Infrastructure, Environment and Innovation
<table>
<thead>
<tr>
<th>Editors</th>
<th>François Lienard, Frank Neumann</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contributors</td>
<td></td>
</tr>
<tr>
<td><strong>Frank Neumann</strong></td>
<td>Institute for Infrastructure, Environment and Innovation</td>
</tr>
<tr>
<td><strong>Peter Stenzel</strong></td>
<td>University of Düsseldorf</td>
</tr>
<tr>
<td><strong>Pieter Hack</strong></td>
<td>REDStack</td>
</tr>
<tr>
<td><strong>Oystein Skramasto</strong></td>
<td>Statkraft</td>
</tr>
<tr>
<td><strong>Olivier Schaetzle</strong></td>
<td>Wetsus</td>
</tr>
<tr>
<td><strong>Inge Genné</strong></td>
<td>Vito</td>
</tr>
<tr>
<td><strong>Etienne Brauns</strong></td>
<td>Vito</td>
</tr>
<tr>
<td><strong>François Lienard</strong></td>
<td>Institute for Infrastructure, Environment and Innovation</td>
</tr>
</tbody>
</table>
SALINITY GRADIENT POWER GENERATION

Brussels, The 13th of April 2011
Dutch House for Education & Research
(Rue d’Arlons 22, 1050 Bruxelles)

European Meeting

PROGRAMME

13.30 Opening of the meeting room

13:45 Welcome from Institute for Infrastructure, Environment and Innovation (IMI)
   ➢ Mr. Frank Neumann, IMI

14.00 Resource assessment for osmotic power plants in Europe and worldwide
   ➢ Mr. Peter Stenzel, Zentrum für Innovative Energiesysteme

14.30 Recent developments in Reverse Electro Dialysis (RED): real condition pilot project
   ➢ Mr. Pieter Hack, REDstack

15.00 The Norwegian solution for Blue Energy: Pressure Retarded Osmosis developments (PRO)
   ➢ Mr. Oystein Skramesto Sandvik, Statkraft

15.30 Open discussion and questions about PRO & RED

15.45 Coffee Break

16.00 The CAPMIX project: novel principle for electricity generation from the mixing process
   ➢ Mr. Olivier Schaetzle, Wetsus

16.30 Energy generation and desalination: The REAPower project
   ➢ Mr. Etienne Brauns, VITO

17.00 The INES Initiative: Working together for enhancing salinity gradient visibility
   ➢ Mr. Frank Neumann, Institute for Infrastructure, Environment and Innovation
   ➢ Mr. François Lienard, Institute for Infrastructure, Environment and Innovation

17.20 Conclusive discussion and looking ahead
17.30 End of conference
## Table of contents

Introduction: .......................................................................................................................... 5

Frank Neumann, Introduction to the INES project................................................................. 6

Peter Stenzel, Resource assessment for osmotic power plants in Europe and worldwide ...... 8

Pieter Hack, A new source of Sustainable Energy From Laboratory to Pilot, into the Future 13

Oystein Skramseto Sandvik, Why osmotic power? ............................................................... 17

Olivier Schaetzle, Capmix project: a way to success for capacitive blue energy ? ............ 20

Inge Genné, Etienne Brauns, Energy generation and desalination : The REAPower project. 23

Conclusion: .......................................................................................................................... 28

Pictures from the conference.............................................................................................. 29
Introduction:

This conference was organized by the Institute for infrastructure, Environment and Innovation in perspective of the INES initiative. This conference purpose is to gather the interested parties for an update on the different initiatives ongoing currently in Europe. The European Commission enabled INES conference to take place as part of the official programme of the Sustainable Energy Week. It was the occasion to have representatives from several countries which are not usually present in Belgium. By this mean, the conference could reach a wider panel of interested parties.

The main players of salinity gradient power in Europe were invited and had the occasion to present their technology and the status of their research. We were pleased to notice the strong interest our initiative rose among a variety of stakeholders.

The discussions were not only technical. It was also the occasion to present the INES initiative in front of an interested panel of potential stakeholders of the salinity gradient energy sector.

Based on the conclusions of the meeting held in Brussels 27th April 2010, the INES initiative was created in order to enhance the development of salinity gradient power and the visibility of this innovative renewable energy production technique.

INES purpose is to find and develop solutions to the common problems identified as crucial for the sector during a dedicated work session in 2010, including bio-fouling, finance of demonstration projects and pilots, water quality, ecological aspects and permitting. In addition it is intended to contribute to the further development of the sector and bringing membrane producers, developers, investors, and other potential funding organisations in better co-operation with each other, jointly with EU, national and regional authorities.

Regarding the European authorities, this exercise is also aimed to bring salinity gradient to the attention of the new European Innovation Agency, the relevant European Topic Centres for example DG Research, DG Region, DG Environment, but also relevant International Bodies.

The conference was also attended by representative from the European Commission. Indeed, the salinity gradient power technology already benefits from 2 FP7 funding programmes (presented below) and the interest for this technology is rising since several years. This event was the occasion to learn what the current development stage is, possible expectation in terms of commercial application and strategies of the sector players. The results of the conference are presented in this report.
Frank Neumann, Introduction to the INES project
Institute for Infrastructure, Environment and Innovation, Belgium

Some history...

- International Survey performed for the Dutch Ministry of Economic Affairs in 2009
- Conference on Salinity Gradient Power organised in Brussels on 27 April 2010
- Further international exploration and development during the first half of 2011

Establishing a content related network specifically dedicated to salinity gradient energy:

1. make salinity gradient energy more known
2. focused on project level: help and facilitate pilot projects to make further steps
3. international networking and exploration
4. facilitating investments- also at local level, assist in finding finance
5. providing neutral information, supported by stakeholders

How?
- Working programme on identified relevant topics
- Site visits
- Financing information-brokerage specifically on salinity gradient energy
- Involvement of key actors of the sector, also outside EU
- Special research/quickscan actions, decided by partners
- Website and newsletter, others??

INES WORKING TOPICS:
INES PROGRAMME

Seminar I: End summer 2011 (Oslo – Norway or ....)
Central Theme: Technical aspects and energy potential of PRO/RED
Additional topic: contribution of the supply chain (pipes, pumps and membrane producers)

Seminar II: October 2011
Central theme: Anticipated environmental issues and mitigation measures (membrane cleaning, treatment of water, filtration and brackish water release)
Additional topic: the joint cooperation on water treatment between PRO/RED

Seminar III: March 2012
Central theme: PRO/RED Site selection methodology, feasibility studies and worldwide perspective
Additional topic: the EU related regulation for water and estuary protection

Seminar IV: End September 2012
Regional, National and European support schemes for PRO/RED and its financial aspects
Additional topic: How can institutional contact contribute?

Concluding Seminar : January 2013
Enhancing the salinity gradient power in the energy mix. Summary of the solutions and actions
Peter Stenzel, Resource assessment for osmotic power plants in Europe and worldwide
University of Dusseldorf, Center for Energy Research, Germany

Thesis outline:

• Potential and system analysis of osmotic power plants
• Focus: Pressure-Retarded-Osmosis (PRO)

Main topics:

1. Technological fundamentals and characteristics
2. Potential analysis – river and ocean water
3. Potential analysis – alternative applications
   - (industrial) waste water, mining solutions
   - salt lakes and other natural salt solutions
   - combinations with seawater desalination plants
4. Potential analysis – energy storage by osmotic power

Definition of Potential term:

**Theoretical potential**
- Physical maximum usable energy, given by the Gibbs Free Energy of mixing ($\Delta G$)

**Technical potential**
- Technical constraints of the energy conversion process are taken into account (PRO power plant model)

**Ecological potential**
- Water availability constraints are taken into account (amount of extractable river water)

**Economical potential**
- Costs for generating electricity (different power plant configurations, scenario calculations, site specific analysis)

**Theoretical potential of salinity gradient energy**
- Calculation based on global mean values for salinity, temperature and discharge
- Theoretical potential is independent from a concrete conversion technology
Limited relevance, because only a small amount of the theoretical potential is exploitable in practice.

Technical potential - definition

- The technical potential is a subset of the theoretical potential.
- Technical constraints of the energy conversion process are taken into account.
- The technical potential is related to the energy conversion technology (power plant model).

<table>
<thead>
<tr>
<th>Continent</th>
<th>theoretical potential [GW]</th>
<th>[TWh/a]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Europe</td>
<td>241</td>
<td>2,109</td>
</tr>
<tr>
<td>Africa</td>
<td>307</td>
<td>2,690</td>
</tr>
<tr>
<td>Asia</td>
<td>1,015</td>
<td>8,890</td>
</tr>
<tr>
<td>North America</td>
<td>479</td>
<td>4,195</td>
</tr>
<tr>
<td>South America</td>
<td>969</td>
<td>8,492</td>
</tr>
<tr>
<td>Australia*</td>
<td>147</td>
<td>1,291</td>
</tr>
<tr>
<td>World</td>
<td>3,158</td>
<td>27,667</td>
</tr>
</tbody>
</table>

*: incl. Oceania

<table>
<thead>
<tr>
<th>Continent</th>
<th>technical potential [GWel]</th>
<th>[TWhel/a]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Europe</td>
<td>49</td>
<td>395</td>
</tr>
<tr>
<td>Africa</td>
<td>63</td>
<td>503</td>
</tr>
<tr>
<td>Asia</td>
<td>208</td>
<td>1,663</td>
</tr>
<tr>
<td>North America</td>
<td>98</td>
<td>785</td>
</tr>
<tr>
<td>South America</td>
<td>199</td>
<td>1,589</td>
</tr>
<tr>
<td>Australia*</td>
<td>30</td>
<td>242</td>
</tr>
<tr>
<td>World</td>
<td>647</td>
<td>5,177</td>
</tr>
</tbody>
</table>

*: incl. Oceania
Technical potential – results (PRO process)

- Pumping power and pre-treatment system are not considered (site specific)
- The practical relevance of the technical potential is also limited because the availability of river water and ecological constraints are not considered

Ecological potential – definition

- The ecological potential is a subset of the technical potential
- The ecological potential takes the amount of extractable river water into account
- The amount of extractable water is very site specific and limited by the ecological stability of the river and / or legal regulations

Main Question:

How much water is extractable out of a river for the use in osmotic power plants?

Ecological potential – water availability analysis (example)

Major findings:

- River water discharge is often highly fluctuating (during one year, for different years)

vs.

- Constant river water availability is important for the operation of osmotic power plants to reach high capacity factors (no dynamic adaption)

and
• Ecological constraints have to be considered

Definition of the extraction factor (based on discharge characteristics of the major river’s in Germany)

**Ecological potential – definition of the extraction factor**

**Extraction factor:**

10 % of the annual mean discharge (MQ) is extractable for a use in osmotic power plants in a mean discharge year

**Ecological potential – results (PRO process)**

• According to the worldwide ecological potential, the maximum contribution of osmotic power plants to the worldwide electricity consumption is approx. 3.1 %

• The defined extraction factor is a major influence parameter

**Ecological potential – parameter variation**

**Major findings:**

• Capacity factor decreases with increasing extraction factor

• Increasing costs for generating electricity with increasing extraction factor

• Legal regulations have to be considered (permit for large scale water extraction?)

• Definition of the extraction factor is highly individual (depending on river discharge characteristics)

• Further research is necessary to determine the extraction factor (hydrodynamic modelling of river ecosystems)

**Question:** Are all rivers suitable for an operation of osmotic power plants?

**Selection criteria:**

Regions where rivers with vertical salinity gradients are predominant (Fjord-type or salt wedge estuaries)

Regions/rivers with very high sediment load are excluded (South-East-Asia, North-Brazil)

• Not all rivers in the selected regions will offer suitable conditions

• Additionally, rivers with suitable conditions for osmotic power plants are to be expected in other regions
Conclusion

• For a meaningful potential assessment for osmotic power plants it is not sufficient to consider only the theoretical or technical potential

• Another very important factor is the amount of extractable river water which defines the ecological potential

• - The definition of the extraction factor is very site specific
  - Legal regulations for large scale water extractions are unclear
  - Detailed modellings of the impacts on the river-ecosystem are necessary (dynamic habitat modelling)
  - An analysis of the impacts of the mixing water disposal is also essential
  - The costs for generating electricity are affected by the extraction factor

• Especially fjords or salt wedge estuaries offer suitable conditions for osmotic power plants (relatively stable salinity conditions, short water transport system)
In this technology, there is no special need for fresh water. It can produce electricity only by using the difference in salinity gradient.

The above figure presents a membrane stack. Anions and Cations are crossing semi permeable membrane, thus generating electricity.
Development and upscaling of RED-technology, actual work is focused on following points:

Pre-treatment of water:
- robust filtration
- ability to treat large water quantities
- low cost per m³
- low energy consumption per m³

Membrane development:
- low resistance
- low cost (less than 5€ / m²)
- large quantity (up to 100km²)
- 2w/m²
- ion-selective / perm-selectivity

Stacks:
- cross flow stacks (less spacers needed)
- less resistance

Commercialisation of RED-technology by
- Processdesign
- Key-components
- Technology-licenses to contractors & users

Rotating screens are explored as possible solution:
- 5m³ / second
- Use 5% of energy generated
- 1/3 of total investment
Pilot in surface water:

No holes should be made in the Afsluitdijk. The necessary pipes go above. However, there remain ecological questions, for instance, how to deal with the fishes? Brackish water discharge?

The first exploration of the technology showed no major complication. Financing remains an important aspect for the development of REDSTACK power plant. The project needed 8 permits which are now granted. Its installation will last from 2011 to 2014. Financing partners are welcome.
Next years:
Membrane development
Stack development
Upscaling pilot into demo
Upscaling demo into full-scale
  - Industrial
  - Surface water

In The Netherlands, potential development:

200 MW at Afsluitdijk
500 MW in Botlek
1000 MW in Rotterdam
Several industrial of ½ to 5 MW

Artist representation of a RED power plant sited in a tidal barrage location
Oystein Skramesto Sandvik, Why osmotic power?
Statkraft, Norway

Statkraft in figures:

The osmotic energy generation involves the following advantages:
- Base load
- Small ecological footprint
- Decentralized source of energy
- Based on proven technology

The idea of generating energy with membrane is not new. It was invented and demonstrated by Sydner Loeb in the 70’s. Since then, Statkraft worked in developing it’s own osmotic power technology until the opening of the Osmotic Power Plant in Norway in 2009.

The vision of Statkraft is a step by step development which should lead to a major take off of the Osmotic Power (OP) in every suitable site globally.
The next significant step should be the opening of a 2MW pilot plant in 2013. In 2018, the OP plant from Statkraft should produce electricity at competitive price: 75€ / MW
The sector needs to organise itself: the demand for membranes raises with the development of OP. This should lead to an augmentation of the production capacity of membrane and therefore stabilizing the price of membranes. That is part of the crucial role of the manufacturers in the OP sector: they hold the knowledge of a key component and at the same time, they can strongly influence the scaling up of the power plant to an industrial scale.

Regardless of choice of Business Model - Build skills within:

- Securing framework (legal and economics) - provide OP equal chances for success compared to alternative, new renewables (Offshore wind, Tidal and wave, Solar/PV)
- Site identification (quality of FW and SW sources), securing rights to use sites, facilitate consenting processes
- Perform optimal main design (FEED) of most crucial OP plant systems - membrane characteristics, membrane module set-up, pretreatment, main system relative positioning (optimal flow), automation guidelines, washing system process, which again provides crucial input to:
- Optimal O&M of OP plants - membrane maintenance, membrane survivability, tune pretreatment/filter cleaning, reduce internal power consumption, secure right level of automation and labor, washing processes. Skills essential in order to be able to:

Further from manufacturers, governments also play a role. The governments can help the development of the sector by considering OP in the energy mix as a renewable energy source. As a major stakeholder in the development, utility companies can support the OP in increasing their will for investing. An easy access infrastructure for energy transport will also be an useful support measure. They should consider the development of OP as an asset for the energy sector that will bring future consumers to the manufactures.
Capacitive technologies: Two different fundamental mechanisms:

- **Electrochemical double layer expansion:**
  Derived from capacitive deionization (CDI)
  4 steps process
  External energy supply

- **Donnan membrane potential driven process:**
  Continuous energy extraction
  2 steps process
  No external energy supply

**Electrochemical double layer expansion**

1. Double layer
2. Sea water goes in between (+ & - charge)
3. The layers accumulate the charge
4. River water flows in between
5. The charge accumulated can be used as power

The layers are composed of activated carbone. Originally, an external power source needs to be connected to the layers so that they can catch the ions + and -. Afterwards, the external power supply can be stopped and the alternative flow of saltwater and freshwater in between the layers allows constant electricity production.
The Donnan driven process

Adjunction of ion selective membrane to the activated carbon layers allows energy generation without external power supply.

1. Seawater flow and charging of electrodes
2. Riverwater flow and electricity discharge

This figure above shows the power output per m²

View of the laboratory device of capacitive mixing with zoom on the layer of activated carbon
Summary of both processes
- Capacitive: ion storage and release at higher potential
- Two distinct mechanisms either energy is required or membranes

Competitive aspects
- Possible positive effects regarding biofouling (charge/discharge, no spacer)
- Open possibilities for cell-design (stacks not mandatory)
- Current power production with donnan driven process: 1.6 W/m² peak power, 0.2 W/m² average power

5 Countries, 6 Partners in the Capmix project
- A consortium of groups of excellence
- Specialized network with 75% of the currently published paper in capacitive blue energy
- A strong vision with belief in success

Follow up actions
- October 2012 in Milan (Italy): Symposium on the potential of salinity gradient energy
- October 2014 in Leeuwarden (Netherland): Symposium based on the outcome of the project
Inge Genné, Etienne Brauns, Energy generation and desalination : The REAPower project

VITO

Facts & Figures

- Founded in 1991
- Autonomous public research company
- Bridge between academia – government and industry
- 5-year framework contract
- Nearly 600 people, 10 nationalities
- Yearly budget of €70 M
- Top technological research in a number of topics relevant to environment, energy and materials
- Introduction and demonstration of innovative technologies
- Technological support to SME’s

Membrane technology at VITO

Membrane/module development:
- Polymeric membranes
- Ceramic membranes
- Electrodes/separators

Membrane processes:
- MF/UF/NF/RO/MBR/PV/ED + membrane distillation, RED

Membrane applications:
- Water treatment
- Solvent filtration/affinity separation
- Biomass filtration (downstream processing)
- Enzymatic membrane reactors (enzyme immobilisation)
- In situ product recovery from fermentation broths
- Elektrochemical cells

The REAPOWER project targets an innovative concept based on the reverse electrodialysis technology. This technology consists of the extraction of the “osmotic energy” from two salt solutions showing a large difference in salt concentration, what is called salinity gradient power (SGP).

» The objective of REAPower is to prove the concept of electricity production through SGP-RE using brine and sea (or brackish) water and to develop the necessary materials, components and processes.

» Time frame: 4 years ; October 2010 – October 2014

Principle
Just as in the RED power plant, water with different salt concentration are passing through membranes. The particular advantage to use sea water and saline brines rejected by desalination plants is:

» highly conductive seawater (e.g. 35 kg/m³) in the LOW compartment
» even more conductive concentrated brine (e.g. 300 kg/m³) in the HIGH compartment creates a low resistance in both the HIGH and LOW battery compartments

As a result:
Opportunity to target a low total internal resistance within the SGP-RE battery cell-pairs through the introduction of thinner membranes.

In principle, a lower battery internal resistance should significantly promote a higher power density of the SGP-RE battery. (See picture below)

![Graph showing the effect of membrane thickness, temperature, and seawater compartment width on maximum power output.](image)

(Source: Vito, E. Brauns, Desalination 237 (2009) 378–391)

The use of saline brines and seawater brings a theoretical advantage in the fact that those water bodies offer significantly less electric resistance than freshwater as shown on the charts below.
The system allows then the use of thinner membranes, which also increases the efficiency of the module:

The SGP plant makes energy by using the saline brines rejected by the desalination plant. But it also generates extra potable water by extracting the water out of the brackish water released (byproduct of SGP energy generation) as shown on the picture on page 26:
1 - The seawater desalination unit (SWDU) based on whatever technology (even 100 % solar power driven) produces saline brines which can be used for osmotic energy production; 
2 - The brine osmotic energy is further increased through solar energy based evaporation of the SWDU brine, up to a high salt concentration; 
3 - About 75 % of additional fresh water can be produced; 
4 - The SGP-RE battery produces electricity by using seawater in the LOW compartments and highly concentrated brine in the HIGH compartments; 
5 - When having a brine stock, the SGP-RE unit enables to produce electricity day and night; 
6 - To maintain a high battery power output, “diluted” SGP-RE exit brine can be re-send to the solar driven evaporation unit to re-concentrate the brine in order to keep the salinity gradient at a high level between IN and OUT of the SGP-RE battery; 
7 - The concentration of the battery mixed effluent discharge stream can be targeted to be low, thus assisting in solving the SWDU brine disposal problem;

The REAPOWER project is composed of the following members:
- FUJIFILM, the University of Calabria and VITO are membrane experts
- KRATON is active in the materials field
- Next Technology Tecnotessile and the University of Cambridge cover the textile technology
- REDSTACK is specialized in the reverse electrodialysis technology
- The University of Palermo is specialized in modeling, simulation and pilot installations
- The University of Palermo also participates with its electrochemistry research unit with respect to the SGP-RE stack electrodes
- Solar Spring develops desalination and water treatment technologies
- WIP and KEMA are consultants in desalination and renewable energy technologies
A prototype unit of the developed technology will be designed, constructed and tested in the saline pond salt factory. Extensive testing of the laboratory stack in order to evaluate the effect of the hydraulic conditions and to study the effect of the real feed composition on the process.

The effect of hydraulic conditions on the power density will be evaluated on a larger laboratory stack.

The combination of this technology with a membrane distillation concept and the pre-treatment requirements of different brine inputs will be assessed as well as environmental impacts.

This will allow proving the concept of the SGP-RE technology under real operating conditions using nearly saturated brine in combination with seawater. The current and post-development cost of the technology and the perspectives for the SGP-RE system will be studied, based on economics, technology and potential of the brine resources.
Conclusion:

Several important outcomes can be made from the salinity gradient power conference. The event has shown that there’s a strong interest from a variety of stakeholder. The European Commission, regional authorities, utility companies, membrane developers, universities and energy companies were attending the event.

The purpose of the conference was to give an overview of the latest developments and ongoing projects that are happening in Europe. The seminar was also presenting the constraints for installing salinity gradient energy. As the technology is related to the water discharge and salt gradient, it is important to assess properly the sites as the efficiency depends on a combination of factors (see presentation 2 – Peter Stenzel).

The second important aspect is the remaining steps that still need to be taken for a commercial stage development. Currently, several processes are ongoing for up-scaling salinity gradient power devices. In Netherlands, the REDStack technology plans to be implemented on the Afsluitdijk around 2015. That would be an important step forward as the demonstration plant would then be tested in real condition water. The plant is estimated to deliver 200MW to the grid once fully installed. (See presentation 3 – Pieter Hack).

The sector needs more structure in order match the industrial requirement for up scaling. Indeed, one of the major constraint is the price of the membrane and it is foreseen that a unified salinity gradient power sector would help reducing the membrane price. The electricity will be produced at a competitive cost in 2018. (See presentation 4 - Oystein Skramesto)

Salinity Gradient Power still needs research and development in order to tackle the remaining constraints (water pre treatment, biofouling of the membranes,...). However, the interest for this new type of renewable energy is clearly rising among universities and research centers. European funds are now supporting 2 initiatives (REAPOWER and CAPMIX) which are working on tackling the technical difficulties while finding new applications with added value. (see presentation 5 – Olivier Schaetzle and presentation 6 – Inge Genné & Etienne Brauns).

The INES project is an informal initiative which is designed to support the knowledge exchange and visibility of this sector in front of regional actors, energy companies and receiving inputs from the European Commission. Its orientation is neutral and any interested party can become a member and learn about salinity gradient power developments. INES is an informal link with practical applications for project managers.

Listed follow-up actions:

- A particular attention should be also given to outside EU interested parties
- Also a greater variety of partners- of the production chain needed for salinity gradient production will be searched
- Facilitated access to the network should be given to universities
- Project focus is of high importance
- Include also possible financing parties

Organization of a site visit for the INES members in Statkraft’s facilities will take place in end September / October 2011
Pictures from the conference

Introduction to the conference by Frank Neumann

Mr. Hack presenting the REDSTACK pilot project

Mr. Skramesto presenting Statkraft strategy

Mr. Stenzel explains the siting constraints of PRO

General view of the audience

Networking at the coffee break
THE INSTITUTE FOR INFRASTRUCTURE, ENVIRONMENT AND INNOVATION is an independent Brussels-based non-profit organization. Its mission is to initiate and implement projects at European and local level that demonstrate that the development of infrastructure can be reconciled with nature protection and environmental goals.

Apart from initiating, financing, and developing European co-operation focusing on sustainability, occasionally the Institute also gives individual, practical, organisational and legal advice with respect to the implications of European Nature Protection Policy for projects and plans.

IMI gives advice on infrastructure projects, management plans and nature restoration measures, in relation to Natura 2000, not only in coastal zones and estuaries, but also on land based projects, and provides legal risk analysis and checks conformity with European nature protection legalization for development projects, nature restoration measures and integral management plans.

Project funding of the Institute comes mainly from national, local, and regional governments and government project organisations. The start-up of new projects is mostly done independently by the Institute on its own behalf. So far, the working programme has particularly focused on infrastructure within coastal zones, coping with environmental protection and also renewable energy production, implementing and promoting innovative techniques.

IMI is also involved in Marine, Wind and Solar energy and more recently energy generation through salinity gradient and network creation on tidal energy for knowledge sharing. These are the fields in which IMI is active.

The Institute employs a small multi-disciplinary and international staff. Working languages include English, French, Dutch, Spanish, German and Latvian.