



# PROJECT DELIVERABLE REPORT

Grant Agreement no: 260117

## HIPIN

### High Performance Insulation based on Nanostructure Encapsulation of Air

Collaborative Projects  
 FP7

Type: Deliverable

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PU	Public	X
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	



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## 1 Introduction

Article II.4.2.b of standard EC Grant Agreement for FP7 projects stipulates that partners are expected to report with enough details on the actual and expected “use” to be made of the foreground, i.e. on their strategy and specific activities to disseminate and exploit the project results (Article II.29)<sup>1</sup>.

The international nature of the partnership underpins widespread dissemination of results of benefit to wider industry across the EU and beyond, via presentations and publications in industrial and academic conferences and journals, articles and seminars. All such dissemination is subject to agreement from the consortium, ensuring the release of any commercially sensitive information is avoided.

Dissemination and value extraction from the data and knowledge generated in the project has been undertaken within Work Package 8 by TWI, with the full support of all project partners, through the following routes:

- Development and regular update of a project website with both confidential and publically accessible sections (<http://www.hipin.eu>).
- Inclusion of project results on the HIPIN website.
- Production of dissemination materials via scientific papers and trade journal press releases, presentations, posters and other dissemination materials like flyers, and participation in relevant building industry trade exhibitions.
- Maintaining a dissemination log to track all external meetings where results from the project were showcased.
- Coordination with other relevant EU projects was taken up via active participation of the HIPIN team in the activities and events of the Nano-EEB cluster. Most recently, this co-ordination activity has been subsumed within the AMANAC project, a Co-ordination and Support project supported by the EC. TWI, on behalf of the HIPIN partnership, attended these cluster meetings.
- A workshop was held on 10 March 2015 at the demonstration site (project partner Envipark), where HIPIN technology has been applied to walls typical of those found in domestic and commercial buildings. Results of the demonstration, particularly relating to thermal performance were presented.

Some of the activities above will continue beyond completion of the project. Activities which are still planned to be undertaken by the partners include utilisation of the results of the project in the industrial partners’ marketing strategies, to enhance/maintain commercial advantage over competitors, and to expedite bringing of new technologies to the market.

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<sup>1</sup> FP7 Grant Agreement - Annex II – General Conditions Version 6, 24/1/2011



## 2 Dissemination of HIPIN Results

The HIPIN project has a dissemination, exploitation and training work package (WP8) which has included the following specific activities:

- Creating and maintaining a public web site - <http://www.hipin.eu>.
- Informing technical press about the project aim (first phase) and the project results (second phase) focusing on how it will benefit the sector in the long term.
- Attending and presenting papers to specific workshops and technical seminars.
- Production of a flyer which has been distributed at several exhibitions and conferences and updated at the end of the project for future dissemination.
- A HIPIN workshop at which relevant stakeholders from the building industry have been invited; this is being held at Envipark, the site of the demonstrators.

### 2.1 HIPIN dissemination activity

HIPIN has disseminated at the following events:

#### 2.1.1 2012 dissemination activity

Seminars/Conferences			
Event Name	Date	Location	Who
EEB PPP Workshop	March 15-16, 2012	Brussels	TWI
International symposium on super-	April 26-27, 2012	Brussels	TWI
NICOM 4 Conference	May 21-22, 2012	Agios Nicolas, Greece	TWI
6th European Silicon Days	Sep 5-6, 2012	Lyon, France	TWI
XXI International Materials Research Congress	August 12-16, 2012	Cancun, Mexico (no cost charged to HIPIN)	TWI

#### 2.1.2 2013 dissemination activity

Seminars/Conferences				
Event Name	Date	Location	Who	Type of Dissemination Activity
CEPE Annual Conference and General assembly	25-27 Sept 2013	Prague, Czech Rep	ICI	Sponsored event by Akzo-Nobel (ICI)
Passive House	Oct 15, 2013	UK	OR	Attended
Climamed	Nov, 2013	Turkey	OR	Presentation
Mechanical Eng Chamber, MMO	Aug, 2013	Turkey	OR	Presented seminar
EEB Workshop	Mar, 2013	Brussels	OR	Presentation



### Exhibitions & Workshops

Event Name	Date	Location	Who	Remark
European Coatings Congress	Mar 18-19, 2013	Nuremberg/Germany	TWI	<a href="http://www.european-coatings-show.com">http://www.european-coatings-show.com</a>
Ecobuild	Apr 2013	London, UK	VMK, OR	<a href="http://www.ecobuild.co.uk/">http://www.ecobuild.co.uk/</a>
Yapi Fuarı Fair	Apr 24, 2013	Turkey	OR	<a href="http://www.yapifuari.com.tr/eng/">http://www.yapifuari.com.tr/eng/</a>
Euronanoforum 2013 NANO E2B Cluster Workshop	Jun 20, 2013	Dublin, Ireland	ENV	<a href="http://www.euronanoforum2013.eu/workshops/workshop-energy-efficiency-in-buildings/">http://www.euronanoforum2013.eu/workshops/workshop-energy-efficiency-in-buildings/</a>
Made Expo	Oct 2-5, 2013	Milan, Italy	VMK	<a href="http://www.madeexpo.it/en/2013">http://www.madeexpo.it/en/2013</a>
Restructura	Nov 21-24, 2013	Turin, Italy	VMK	<a href="http://www.restructura.com">www.restructura.com</a>
BUILD UP Web Seminar on Superinsulating materials: State of the art applications and long term performance	Nov 5, 2013	Webinar	TWI	<a href="http://www.buildup.eu/news/38814">http://www.buildup.eu/news/38814</a>
High Performance Insulation Workshop	Nov 27-28, 2013	ZAE Bayern	TWI	Workshop

### Articles published

Article Name	Date	publication	Who	Remark
Analysis on existent thermal insulating plasters towards innovative applications: Evaluation methodology for a real cost-performance comparison	Sent for publication July 2013. (Published July 2014)	Energy and Buildings (peer-reviewed journal)	VMK	<a href="http://www.sciencedirect.com/science/article/pii/S0378778814002576">http://www.sciencedirect.com/science/article/pii/S0378778814002576</a>
Research into nano-based aerogels could revolutionise insulation materials used in buildings	August 2013	Technology for change	OR	<a href="http://www.technology4change.com/page.jsp?id=215">http://www.technology4change.com/page.jsp?id=215</a>
Plaster as active element to manage indoor environment thermal conditions in winter and summer		Report	VMK	<a href="http://www.architesi.polito.it/pdf/4368_uk_abs.pdf">http://www.architesi.polito.it/pdf/4368_uk_abs.pdf</a>
Improving the insulation properties of existing building material	2013	Sent to multiple construction journals for publication	OR	Sent to multiple construction trade journals (CIBSE, RICS, RIBA, MMO) for publication but were not published
FP7 EEB cluster video				Completed by OR for Hipin



### 2.1.3 2014 and 2015 dissemination activity

Seminars/Conferences					
Event Name	Date	Location	Who	Type of Dissemination Activity	Link
Indtech-2014	April 9-11, 2014	Athens	TWI	Presented poster	<a href="http://www.industrialtechnologies2014.eu/">http://www.industrialtechnologies2014.eu/</a>
NanoStruc 2014 Conference	May 20-21, 2014	Madrid	TWI	Presented on "Synthesis of a high silicon content material and its use as raw material for new insulating material for the construction industry."	<a href="http://www.nanostruc.info/">http://www.nanostruc.info/</a>
CBEST 2014, International Conference on Building Envelope Systems and Technologies	June 9-12, 2014	Aachen, Germany	VMK	Paper accepted for the conference	<a href="http://www.icbest.de/Programme">http://www.icbest.de/Programme</a>
ECTP-E2BA Conference	June 17-19, 2014	Brussels	OR	Presented a poster and presentation on HIPIN	<a href="http://www.ectp.org/Conference2014.asp">http://www.ectp.org/Conference2014.asp</a>
8th ENERGY FORUM on Advanced Building Skins	October 28-29, 2014	Bressanone, Italy	VMK	Presented a poster on HIPIN	<a href="http://www.energy-forum.com">http://www.energy-forum.com</a>
ICCMREA' 2015	March 23-24, 2015	Rome, Italy	OOR	Present a paper about HIPIN results	<a href="http://www.iccmrea.net/">http://www.iccmrea.net/</a>



Exhibitions & Workshops					
Event Name	Date	Location	Who	Type of Dissemination Activity	Link
KlimaHouse	January 23-26, 2014	Bozen, Italy	VMK	Exhibition	<a href="http://www.fierabolzano.it/klimahouse/">http://www.fierabolzano.it/klimahouse/</a>
ECO build	March 4-6, 2014	London, UK	VMK, ICI	Attended (no cost claim)	<a href="http://www.ecobuild.co.uk/Content/2014-Conference-">http://www.ecobuild.co.uk/Content/2014-Conference-</a>
Mosbuild	April 1-4, 2014	Moscow	VMK	Exhibition - had HIPIN booth and flyers	<a href="http://www.mosbuild.com">http://www.mosbuild.com</a>
EEB-PPP workshop	April 1, 2014	Brussels	TWI	Presentation about HIPIN	<a href="http://www.ectp.org/enewsportal/index.php?option=com_jevents&amp;task=icalrepeat.detail&amp;evid=586&amp;Itemid=0&amp;ve">http://www.ectp.org/enewsportal/index.php?option=com_jevents&amp;task=icalrepeat.detail&amp;evid=586&amp;Itemid=0&amp;ve</a>
1st Cluster Workshop - Advanced Materials and Nanotechnology Cluster (AMANAC) for Energy	April 8, 2014	Athens	TWI	Presentation about HIPIN	
YAPI Fuarlari	May 7-10, 2014	Istanbul, Turkey	OR	Attended exhibition	<a href="http://www.turkeybuild.com.tr">www.turkeybuild.com.tr</a>
ISK-SODEX International mechanical, solar, similar	May 7-10, 2014	Istanbul, Turkey	OR	Exhibition - had HIPIN booth and flyers	<a href="http://www.sodex.com.tr/#thash.Nl1bMgHx.dpuf">http://www.sodex.com.tr/#thash.Nl1bMgHx.dpuf</a>
14th European Meeting on Supercritical Fluids	May 18-21, 2014	Marseille, France	Separex	Attended meeting	<a href="http://emsf2014.com">http://emsf2014.com</a>
2nd AMANAC Cluster Workshop -	Oct 9-10, 2014	Chambery, France	TWI	Present updates on HIPIN to the Nano E2B Cluster (Advanced Materials)	
Seminar on Aerogel	Oct, 6th - 7th, 2014	Hamburg, Germany	Separex	Poster on aerogel manufacturing	<a href="http://www.isasf.net/fileadmin/files/Docs/Flyer_Hambu">http://www.isasf.net/fileadmin/files/Docs/Flyer_Hambu</a>

Articles published					
Article Name	Date	Name of Publication	Who	Remark	Link
Interview with trade journal about HIPIN	June 2014	Yesil Bina	OR	Interviewed in June, awaiting editorial	
Research into Aerogel	2014	Yalitim, Turkey	OR	Submitted 2014, published Jan 2015	<a href="http://www.yalitim.net/?pid=30598">http://www.yalitim.net/?pid=30598</a>
Net zero energy use in building	2014	BEST, Turkey	OR	Submitted 2014, published Jan 2015	<a href="http://www.bestdergisi.com.tr/arsiv/yazi/67-binalarda-net-sifir-enerji-kullanimi">http://www.bestdergisi.com.tr/arsiv/yazi/67-binalarda-net-sifir-enerji-kullanimi</a>

## 2.2 Flyers

An updated flyer for the HIPIN project, showcasing the key exploitable results from the project has been created and will be used to disseminate the project results even after the project.





www.hipin.eu

**PARTNERS**











## HIGH PERFORMANCE INSULATION BASED ON NANOSTRUCTURED ENCAPSULATION OF AIR

**The concept**

HIPIN project aims to develop **sustainable and affordable technology** to produce a **nanostructured thermal insulating layer** based on more **robust aerogel**. This will improve thermal efficiency in new buildings and retrofitting of existing buildings.

**HIPIN aerogel**





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This project is funded by the European Union

## Incorporation into building materials

<p><b>THERMAL PAINT</b></p> <p>Solventless (VOC regulation)          Stable for 2 years/wet and 5 years/dry          Colour and gloss are stable over time          Thickness 20-50µm (dry-film)          Thermal Conductivity &lt; 0.5 W/mK</p>   <p>Short description of the picture ...</p>	<p><b>THERMAL PLASTER</b></p> <p>Pre-mixed (fast application)          Finishing and paintable          Breathable          Thickness 30-60 mm          Dry bulk density &lt; 250 kg/sqm          Thermal Conductivity ~ 0.034 W/mK</p>   <p>Short description of the picture ...</p>	<p><b>THERMAL PANELS</b></p> <p>fast application          Vapour diffusion          Thickness 50 mm          Thermal Conductivity ~ 0.025 W/mK</p>   <p>Short description of the picture ...</p>
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### 2.3 Stakeholder workshop

A stakeholder workshop was held on 10 March 2015 at Envipark in Turin (site of the HIPIN demonstrators) to disseminate the results of the HIPIN project to stakeholders in the building industry. This workshop was jointly held in combination with another EEB project, ECO-SEE to maximise the benefits for prospective attendees.

In addition to the consortium partners, about 25 key stakeholders from various companies and institutes across Europe attended the workshop. There was good engagement and interest in terms of the cost and performance of the aerogel, especially with regards to its durability and performance in an aggressive plaster environment.





### 3 Exploitation of HIPIN technologies

Five key exploitable results from the project and their exploitation potential are summarized in Table 1.

Exploitable result	Partner	Performance benefits	Exploitation potential and status at end of project
ER 1: Precursor TEOS58	TWI and Thomas Swan, UK	A pre-polymerised TEOS precursor with a silica content of 58% represents a significant improvement to the usual precursor (TEOS, 28% silica content) used in aerogel production. The higher silica content enables aerogels to be more robust for incorporation into aggressive building product formulations.	Synthesis at lab-scale but also scale-up robustness demonstrated.  Possibilities to use this know-how in other applications beyond insulation continue to be explored by TWI.
ER 2: Robust hydrophobic aerogel based on TEOS58	Separex, France	A robust hydrophobic aerogel has been developed based on the precursor TEOS-58 (ER1) and using a proprietary method for hydrophobization.	Faster drying and in-line hydrophobization method provides a cost-effective and robust manufacturing process for aerogel granules with low thermal conductivity.
ER 3: HIPIN Thermal insulating plaster	Vimark, Italy	Thermal insulating plaster with aerogel in the formulation gives significant improvement in insulating values over normal plaster, whereby increased thermal performance can be achieved at lower thickness.	Good thermal performance of an aerogel-containing plaster was demonstrated. Formulation optimisation is necessary to provide greater robustness of the product and to understand better the interactions of the aerogel and the plaster constituents.
ER 4: HIPIN Thermal insulating panels	Methodo, Italy	Methodo has developed mechanically robust thermal insulating panels where a polyurethane (PU) - aerogel composite has been enclosed by an polystyrene (EPS) shell. The aerogel composite, which gives high insulating properties to the panels, can be cut to measure and bolted to any support for easy installation.	Higher insulation with reduced thickness and a low-cost method of retrofitting existing buildings has been explored.
ER 5: Paint system with enhanced insulating properties	ICI (Akzo-Nobel), UK	Laboratory and demonstrator studies have demonstrated a paint with insulation benefits.	HIPIN paint has all the desired properties of a standard paint with the additional benefit of some insulation benefit.



**Table 1:** Exploitable results from Project HIPIN

The performance and exploitability of each product are summarized in Table 2.

Exploitable result	Performance	Challenges and needs, if any	Estimate of time to commercialization (from end of project)
ER 1: Precursor TEOS58	A pre-polymerised TEOS precursor with a silica content of 58% has been scaled up to 1000+ litres, with good batch-to-batch reproducibility.	Exploitability depends on aerogel demand.	6 months – 1 year; driven by demand from aerogel suppliers for precursor.
ER 2: Robust hydrophobic aerogel based on TEOS58	A cost-effective and robust manufacturing process for hydrophobic (and hydrophilic) aerogel granules with low thermal conductivity ( $\sim 0.015$ W/(m.K) has been demonstrated.	Surface treatment levels for plaster application may need further development effort.	Depends on demand and scale of operation; needs investment for commercial plant.
ER 3: HIPIN Thermal insulating plaster	Thermal conductivity of $0.034$ W/(m.K) was obtained, demonstrating a huge improvement over traditional plaster.	Needs further formula optimisation to improve robustness.	2 - 3 years.
ER 4: HIPIN Thermal insulating panels	Demonstrated thermal conductivity of $0.025$ W/(m.k) for composite sandwich panel and as low as $0.020$ W/(m.K) for the PU-aerogel composite.	Need to partner with a manufacturing company for developing an automated manufacturing process for the panels.	1.5 - 2 years.
ER 5: Paint system with enhanced insulating properties	Thermal conductivity of $0.49$ W/(m.k) for HIPIN paint, is a possible marketable improvement over standard paint ( $0.64$ W/(m.k)).	Via lab and demonstrator results, have developed a paint with insulation benefits. ICI's commercial and marketing engagement for taking this to market is high.	1 - 2 years.



The timing for commercial exploitability of each result varies and is also captured in Table 2 but is only an estimate at this time and subject to change, based on market dynamics and discussions with partners after the project ends, both within and outside the project consortium.

One of the key factors that will drive commercialization is the price of the aerogel since it can influence the cost vs. performance balance quite a bit for all products. Since the thermal performance and insulating properties of the HIPIN products have been proven via this project, cost and the anticipated payback period is the key driver and also the key hurdle for commercial acceptability by the building and construction industry. Currently, it has been estimated as part of the detailed techno-economic analysis conducted during the project that for a scale of 200-250 tonnes per year of aerogel, the estimated cost is about €2.1/litre of aerogel (this translates to about €12/kg since the density of aerogel is about 180kg/m<sup>3</sup>). For high loadings of the aerogel in the formulation, as in the case of the plaster and the panel, this can have a significant impact on the price of the plaster compared to a non-insulating plaster. However, in the coming years, as the demand for aerogel increases and the investment necessary to put up bigger plants for aerogels is made, it can be anticipated that a price of aerogel of less than €1/litre will be possible, say, at the 5000 tpa scale. This decrease in price will make the commercial exploitability of the HIPIN products possible with a low payback period compared to today.

In addition, for the panel product, the current HIPIN product developed in the project used an external layer of EPS of 1cm on each side in addition to 3cm of the polyurethane-aerogel composite. This was done mainly to facilitate the manufacture of the panels at the pilot scale. However, for a commercial operation, an improved manufacturing process could be set up which did not necessitate this EPS layer. (The EPS has a higher thermal conductivity of 0.26 W/(m.K) as compared to the PU-aerogel of 0.20 W/(m.K).

The benefits of the aerogel containing paint have been highly encouraging to ICI and further investigation to the marketability and commercial viability of this technology is being undertaken at the corporate level.

#### **4 Conclusions**

The dissemination obligations have been met by wide-scale participation in a number of industrial and academic conferences, seminars, workshops, and exhibitions. A small number of articles and press releases in trade journals have also been used to disseminate the project results. A workshop held in the final month of the project was very effective to disseminate information about the final project results to relevant stakeholders. The project website (<http://www.hipin.eu>) will also be maintained after the end of the project, with a final project presentation with the highlights of the project results uploaded at the website.

Five key exploitation results for the project have been highlighted via this report, each of which shows good prospects for commercial exploitability. With the thermal performance having been established via the project, cost will be the main driver for commercialization. As the cost of the aerogel comes down with increasing demand, it is anticipated that the payback period for the investment will be low enough to create a market pull for these novel building insulation products, both for retrofits as well as new buildings.