



The New Steel? Enabling the Carbon Nanomaterials Revolution:
Markets, Metrology, Safety, and Scale-up

*Frost & Sullivan's Study on Potential Market
for Carbon Nanomaterials' Applications*

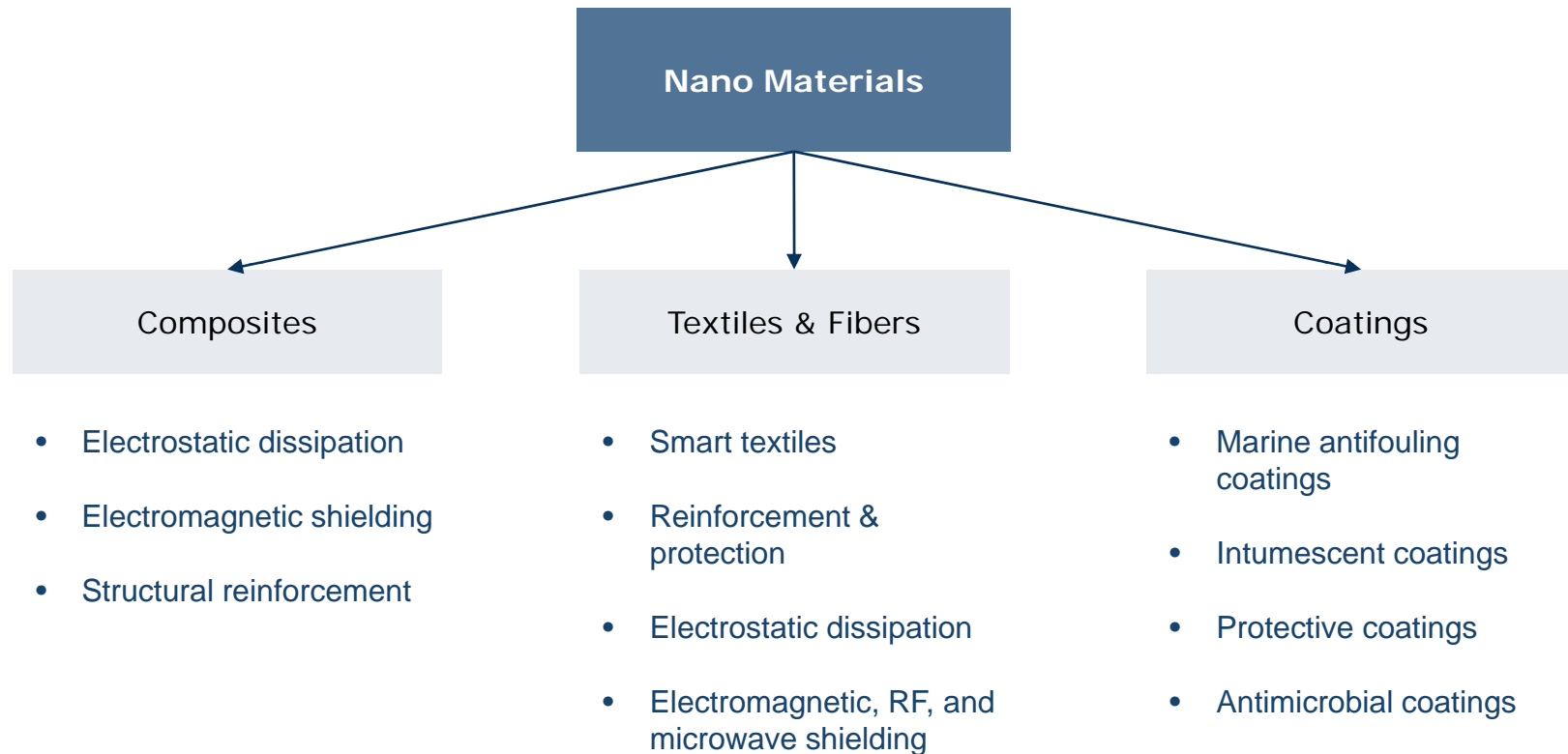
February 28, 2011

F R O S T  S U L L I V A N

Nanomaterials in Composites, Textile and Coatings

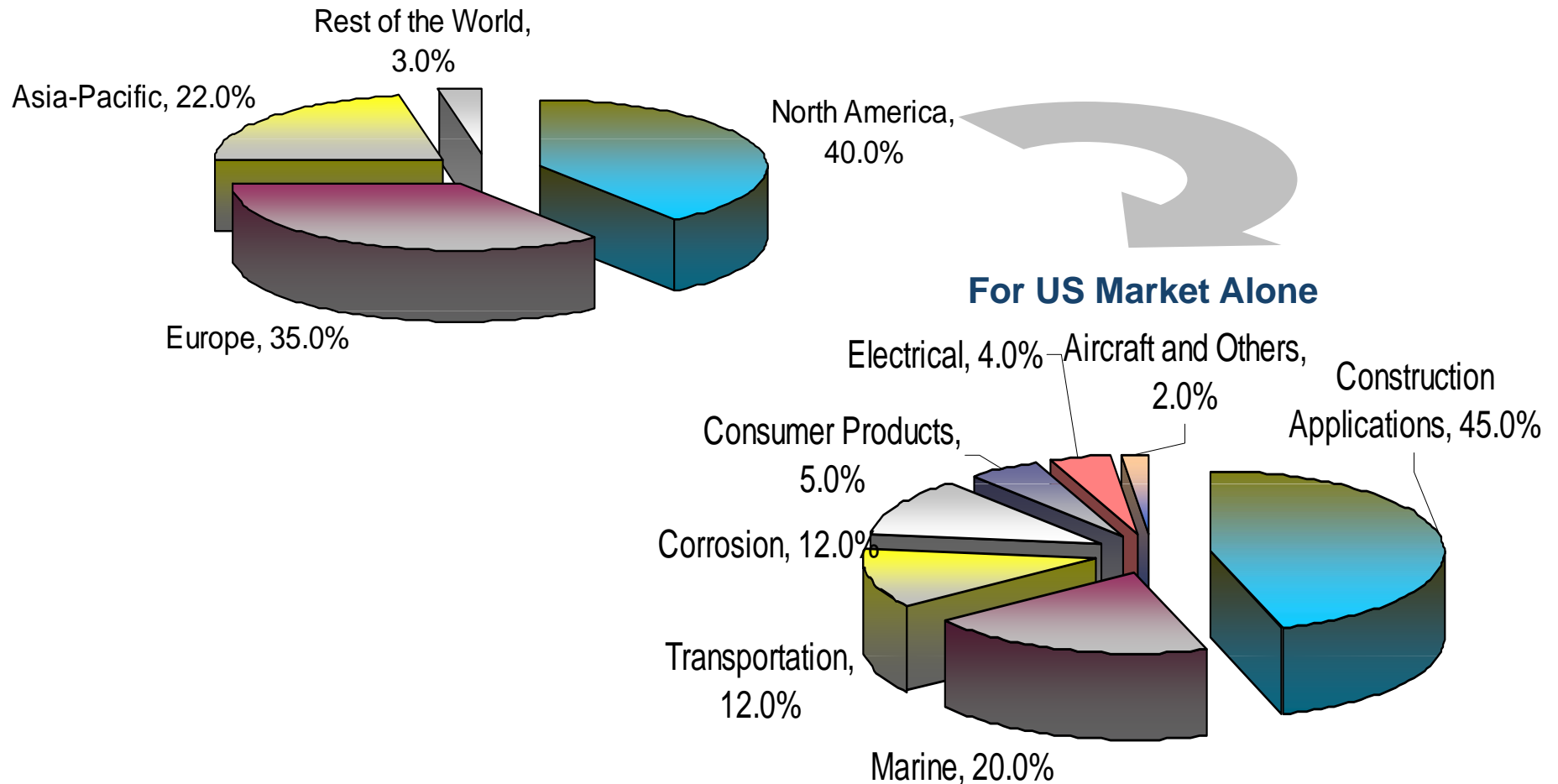


Market Applications for CNTs in Composites, Textile, and Coatings



Source: Frost & Sullivan Research

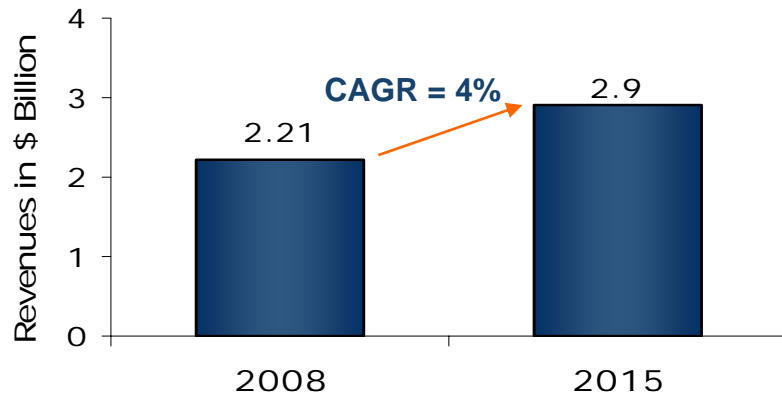
Global Addressable Market for Carbon Nanotube (CNT) based Composites was \$18.79 billion in 2008



Significant growth rates are seen in aerospace & defense, automotive, and construction, within a general industrial rate of 3% to 7%.

Source: Frost & Sullivan Research

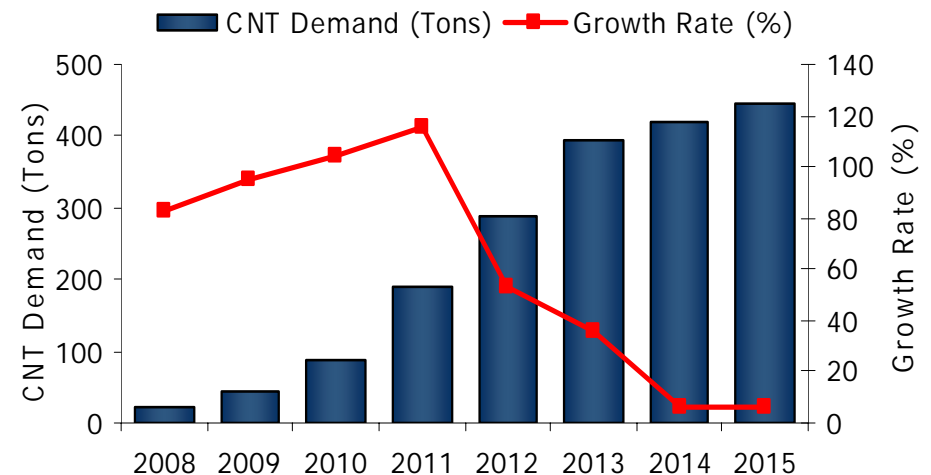
CNT Market Estimation for Automotive Composites (2009-2015)



Total Global market size for automotive composite (2008-2015)



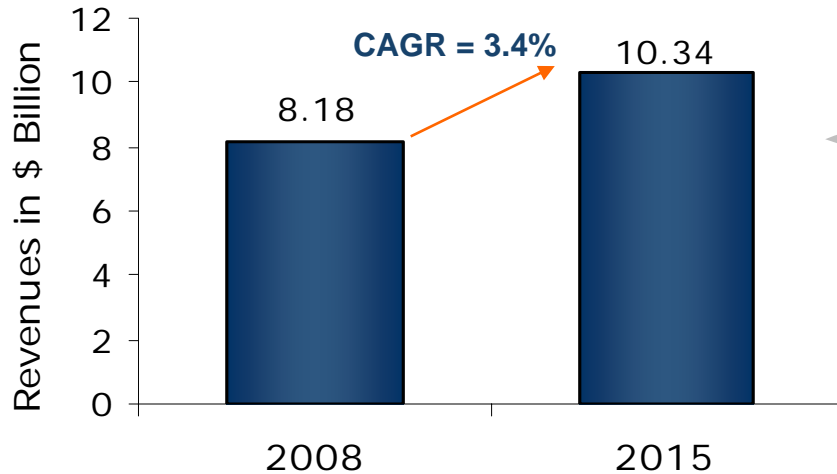
Estimated CNT market size for automotive composite (2009-2015)



CNTs will penetrate about 3.6% within vehicular composites. If 1% carbon nanotubes are loaded into these materials, this means a CNT market for automotive composites of \$35.52 million.

Source: Frost & Sullivan Research

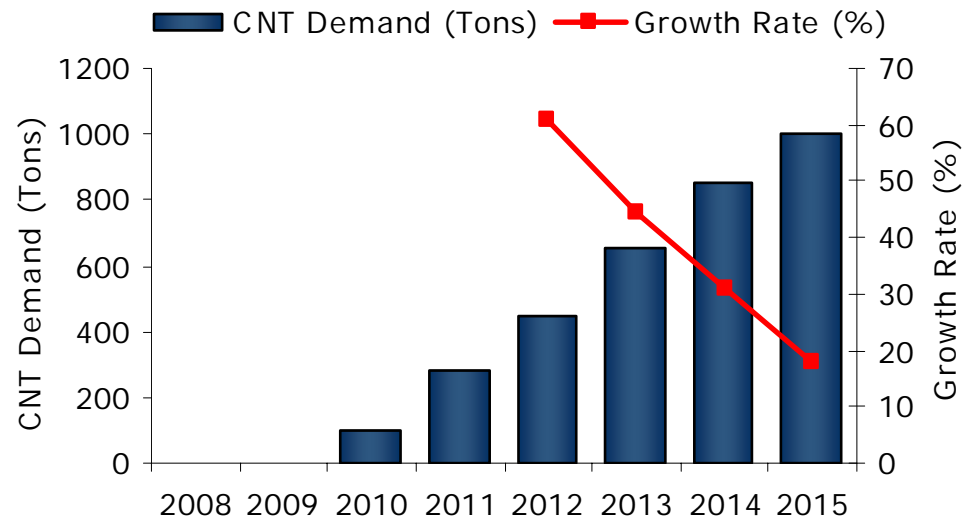
CNT Market Estimation for Construction Composites (2009-2015)



Total Global market size for construction composite (2008-2015)



Estimated CNT market size for construction composite (2009-2015)

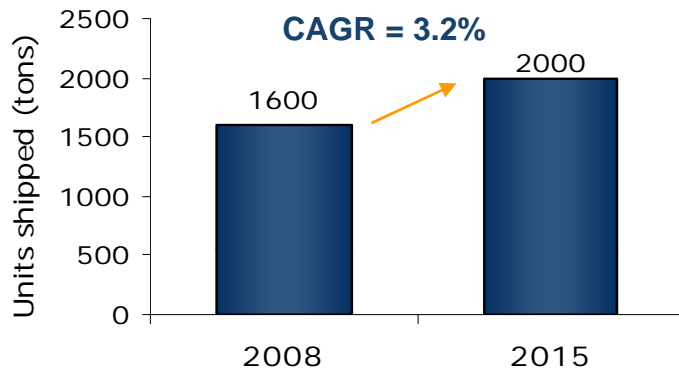


Carbon nanotubes are forecast to begin penetrating construction materials in the current year through 2012, and could penetrate up to 10% by 2015 if nanotech developers can prove and validate their products' ability to reinforce structures.

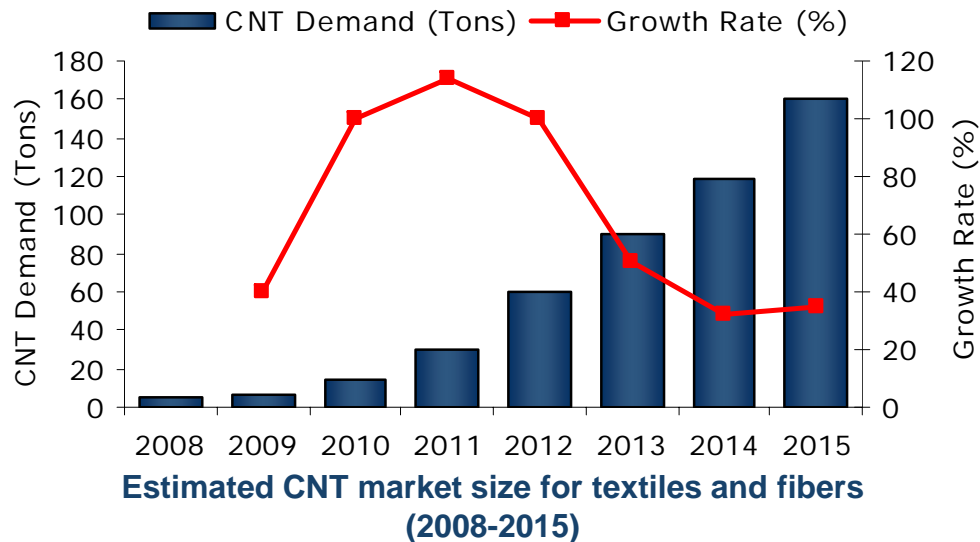
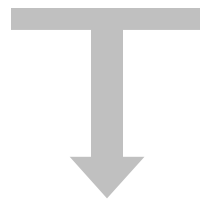
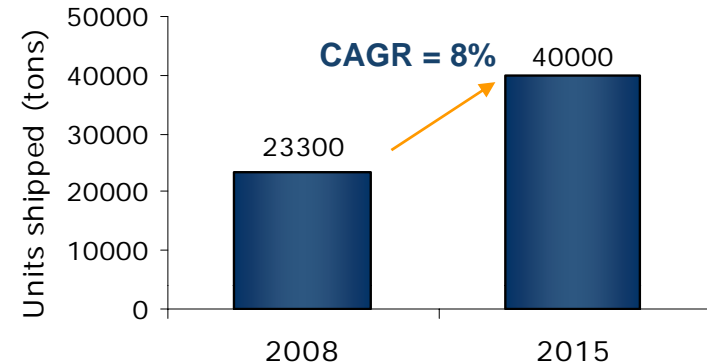
Source: Frost & Sullivan Research

CNT Market Estimation for Textiles and Fibers (2008-2015) - Frost & Sullivan expects penetration of CNTs in this area to commence in 2012, and could reach up to 15% by 2015

Total global market size for ESD textiles & fibers (2008-2015)



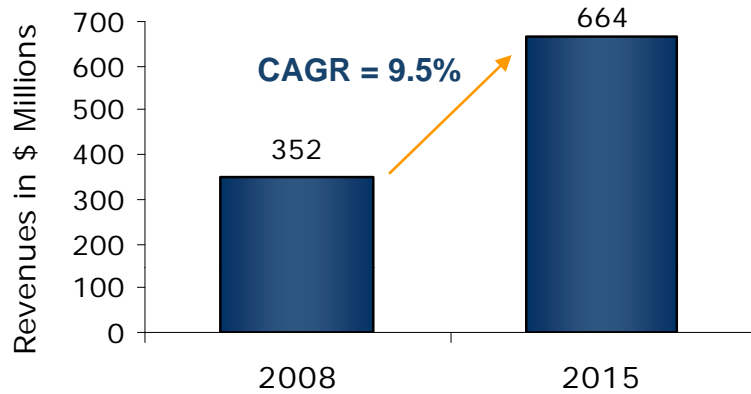
Total global market size for reinforcement textiles & fibers (2008-2015)



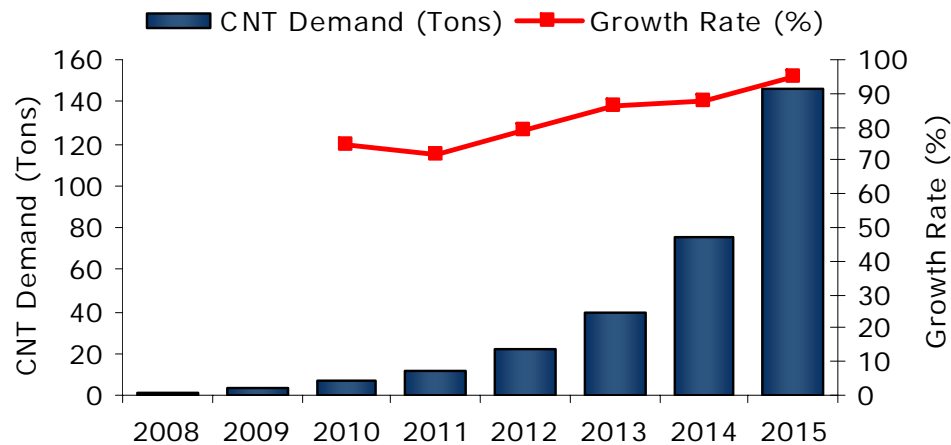
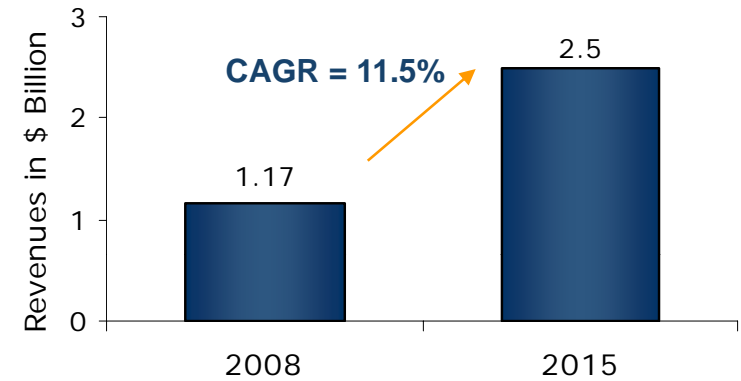
Source: Frost & Sullivan Research

CNT Market Estimation for Coatings (2009-2015) - *Frost & Sullivan projects that CNTs could penetrate up to 25% of the intumescent coating market by 2015 and 2% penetration rate for antifouling coatings also by 2015 at 1% loading rates*

Total global market size for intumescent coatings (2008-2015)



Total global market size for antifouling coatings (2008-2015)



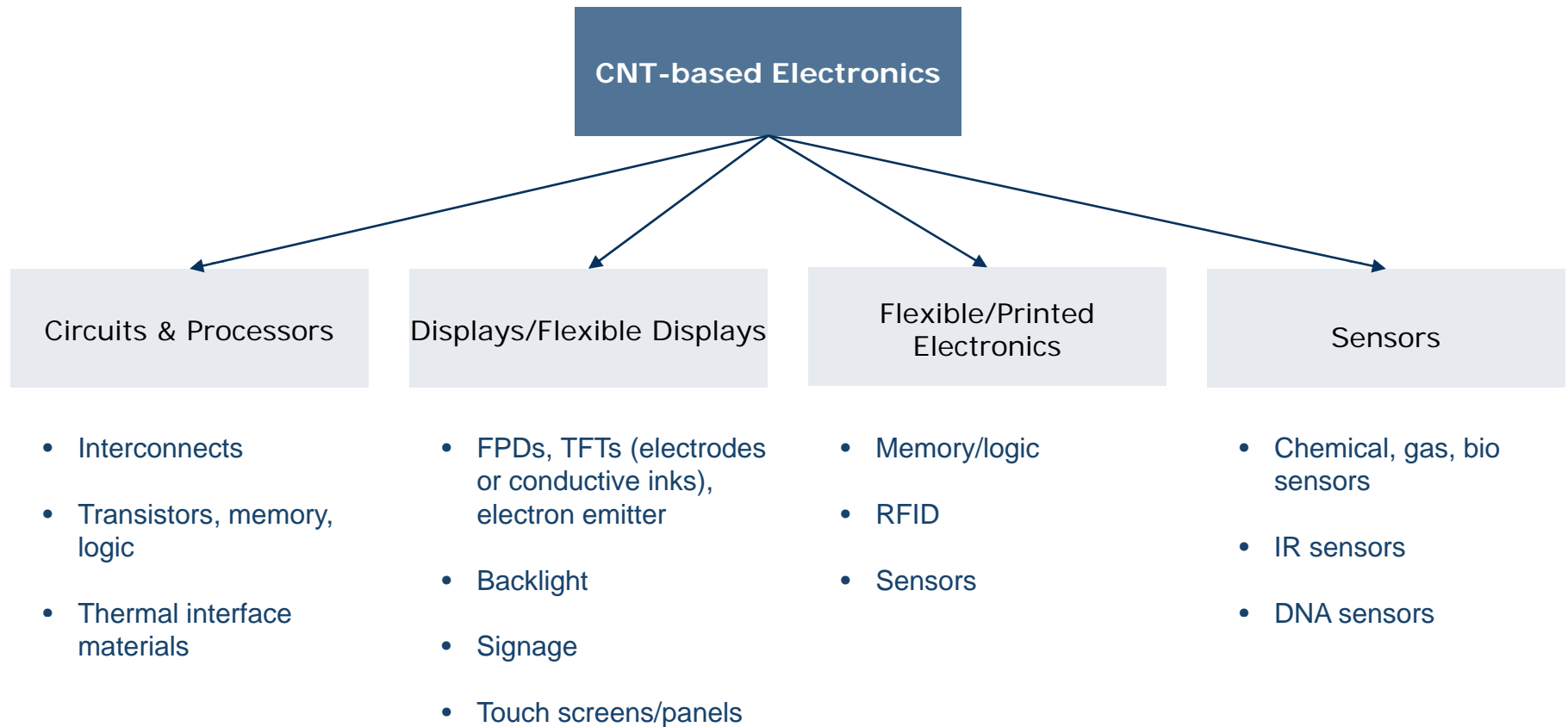
Estimated CNT market size for intumescent and antifouling coatings (2009-2015)

Source: Frost & Sullivan Research

Electronics

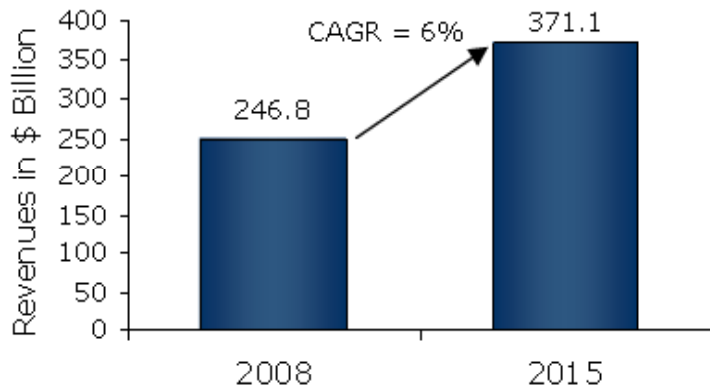


Market Applications for CNTs in Electronics

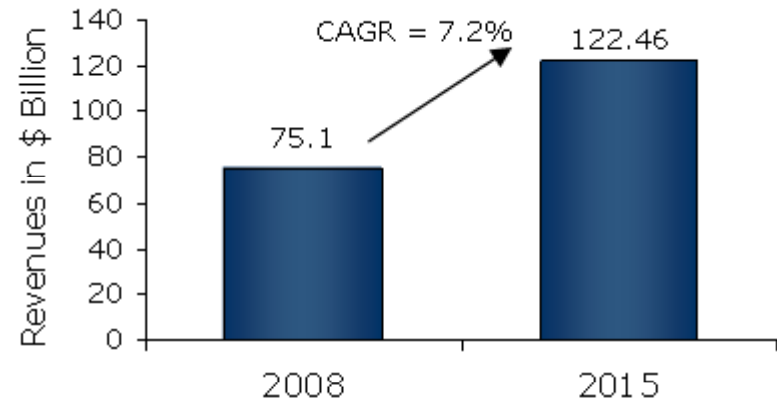


Source: Frost & Sullivan Research

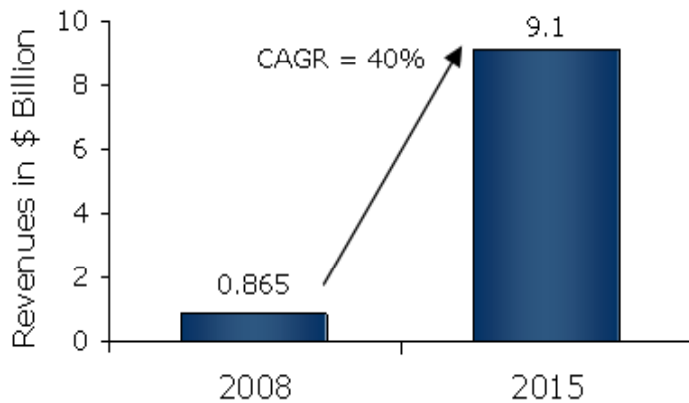
Market Analysis For CNT in Electronic Sub-Segments



Total global market size for the semiconductor IC market (2008-2015)



Total global market size for the display market (2008-2015)



Total global market size for the flexible/printable electronics market (2008-2015)

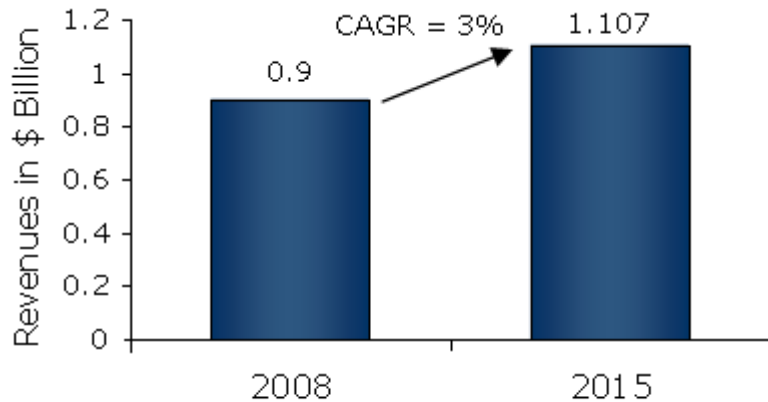
DEVICES	2008	2015
CNT Interconnects	Nil	1% - 5%
Logic and memories	Nil	1% - 2%

DEVICES	2008	2009	2015
Displays	Nil	0.1%	1% - 5+%
Flexible Displays	Nil	Nil	1% - 10%

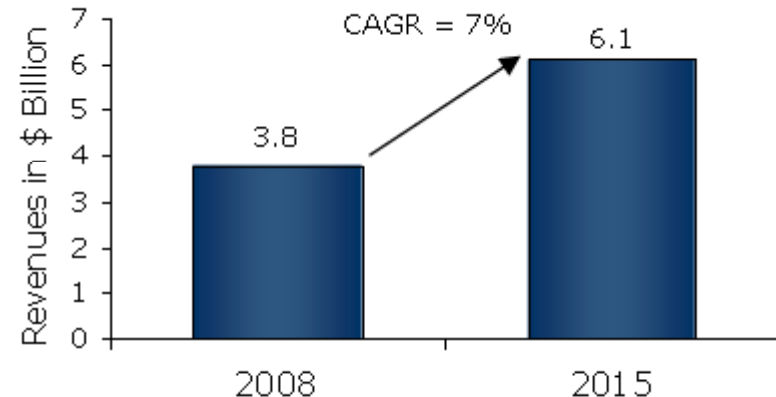
CNT penetration potential

Source: Frost & Sullivan Research

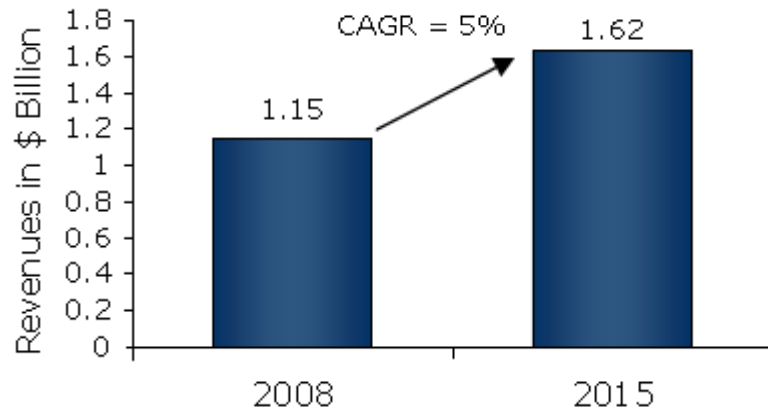
Market Analysis for CNT in Sensors- *Expected Penetration Rate of CNT in these Addressable Markets is 1%*



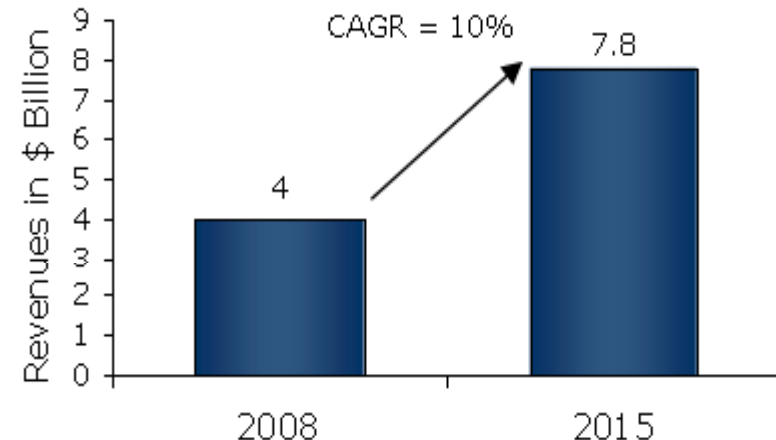
Global market size for the chemical, gas and bioagent sensors in homeland security market (2008-2015)



Global market size for the chemical, gas and bioagent sensors in medical diagnostics market (2008-2015)



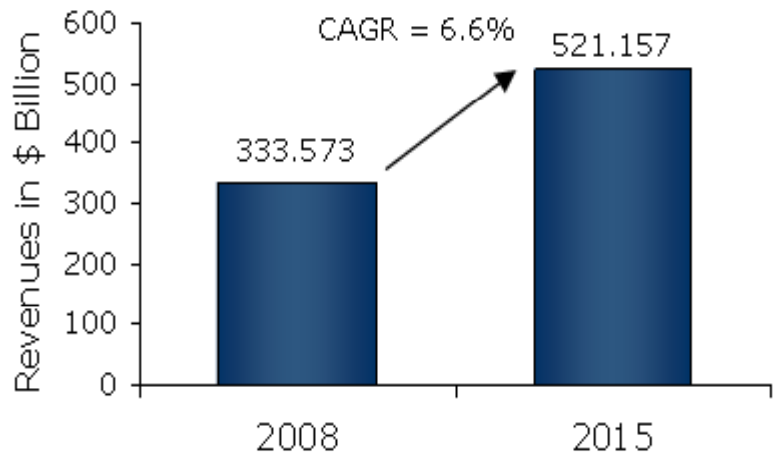
Global market size for the chemical, gas and bioagent sensors in industrial/industrial safety market (2008-2015)



Total global market size for the infrared sensors market (2008-2015)

Source: Frost & Sullivan Research

Market Summary for CNTs in Electronics



Total global market size for electronics (2008-2015)

CNT penetration potential

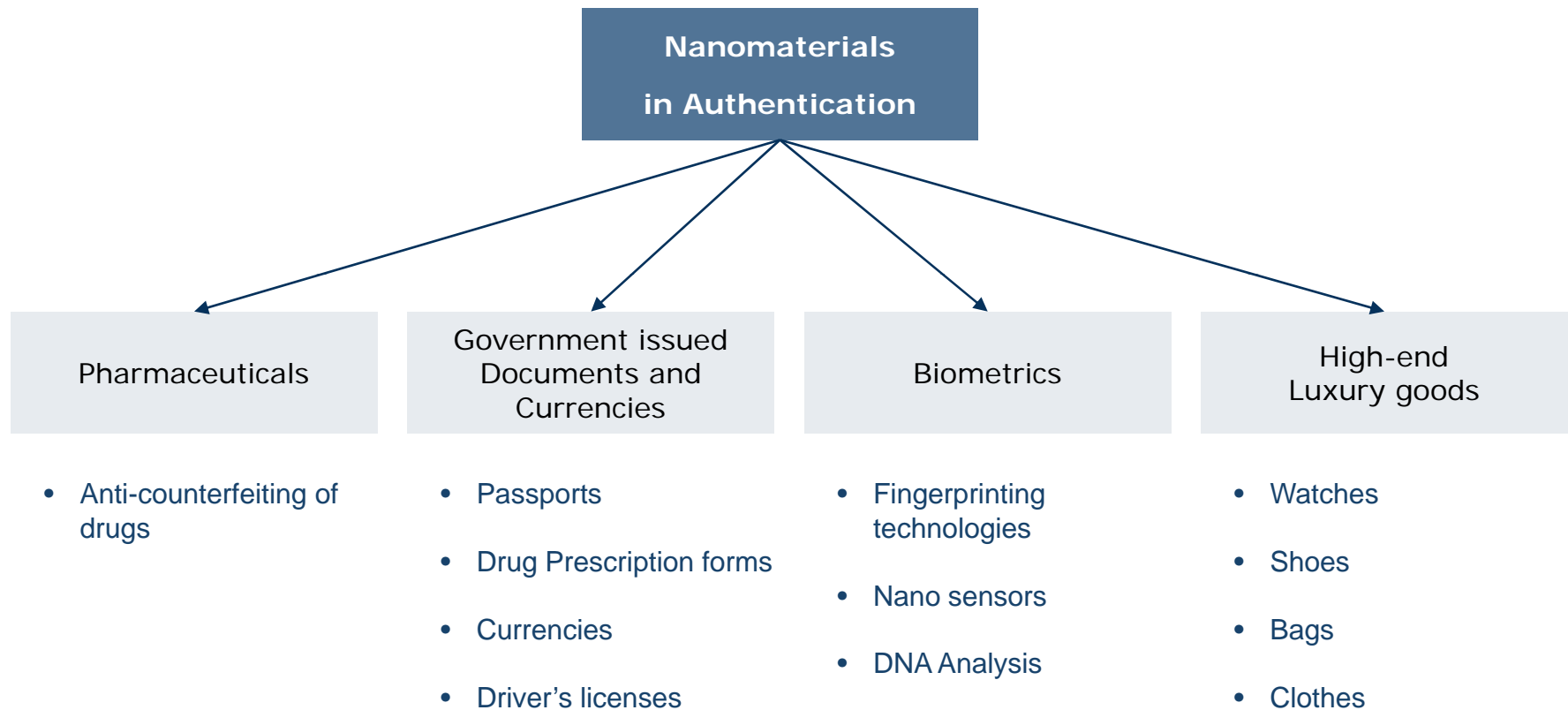
- CNT penetration in the various sensor applications: Likely to be not greater than around 1% during the forecast period (2008-2015)
 - Promising markets- interconnects, displays/flexible displays, chemical/gas and bioagent sensors: CNTs will begin to penetrate by around 2014 or so (within around five years).
 - Other markets - memory, transistors/logic, infrared sensors, DNA sensors, flexible electronics: CNT might take longer time to penetrate.
 - CNTs are expected to have a minor share (e.g., ranging from less than 1% up to possibly 5%) of the overall available market in each aforementioned application segment over the forecast period (through 2015).

Source: Frost & Sullivan Research

Authentication



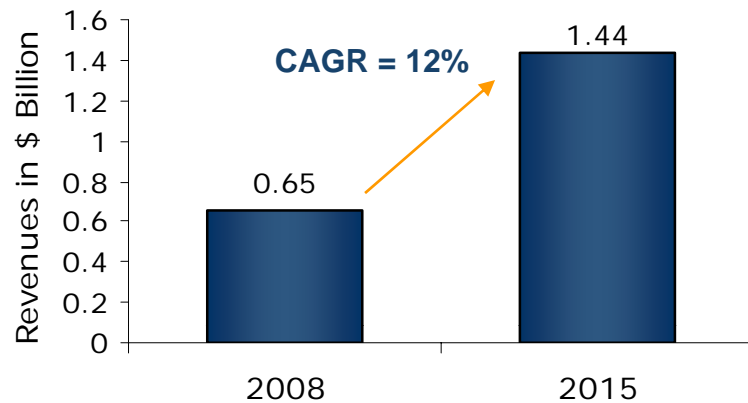
Market Applications for Nanomaterials in Authentication Segment



Source: Frost & Sullivan Research

Authentication Segment Market Analysis and Forecasts - Nanotechnology

may represent about 1-5% of the total authentication market in the forecasted period

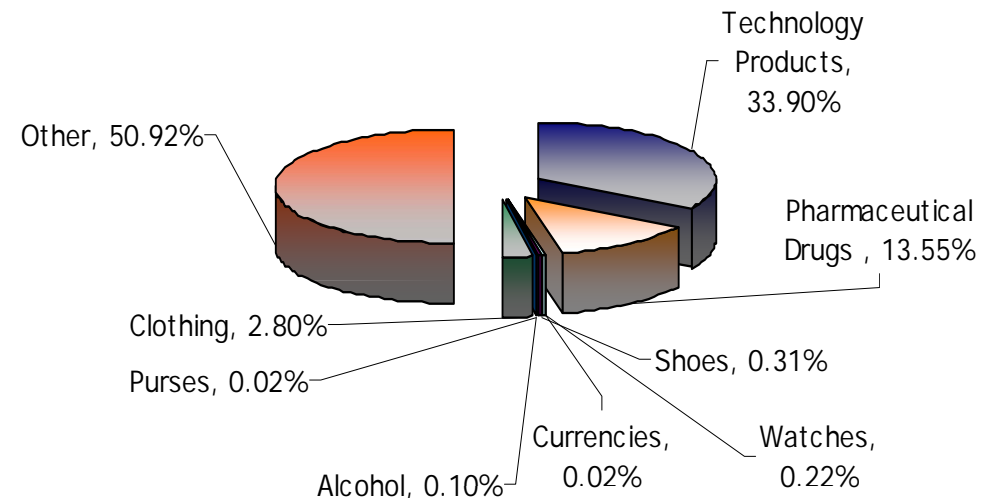


Total addressable market size for Nanotechnology based products in Authentication (2008-2015)

- The total counterfeit market: US\$295 Billion annually
- Counterfeiting of technology products represent about \$100 billion, pharmaceutical drugs at \$40 billion dollars
- Music piracy, airline parts, and mobile phone entertainment make up the 51% of the total



Counterfeit Products Market (% of total market annually)



Source: Frost & Sullivan Research

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