

# Advanced Engineering Building at AUS

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## Situation

- AUS engineering buildings lack the needed interactive technology systems
- These buildings consume huge amounts of non-renewable energy
- Classes can hardly accommodate the present number of students
- The number of engineering students is annually increasing
- A new developed material can be used to enhance the quality and functions of the engineering buildings

### Definition-Graphene (Figure 1):

- A two dimensional one atom thick material with a hexagonal carbon atom structure
- Stable although it is one atom thick
- Considered to be one of the thinnest and strongest materials discovered up until now



Figure 1: Graphene Powder

<http://cnx.org/content/m43579/latest?collection=col10699/1.17>

## Problems

- Choosing the most efficient way to produce large amounts of pure graphene
- Concrete is known to have low tensile strength compared to its compressive strength
- Platinum used in the production of solar panels is very expensive and depleting
- Graphene does not have a band gap for electrical conductivity

## Solutions

- A new way called Chemical Vapor Deposition (CVD) has been discovered to produce pure graphene (Figure 2)
- CVD is chemical process used to produce high purity solid materials

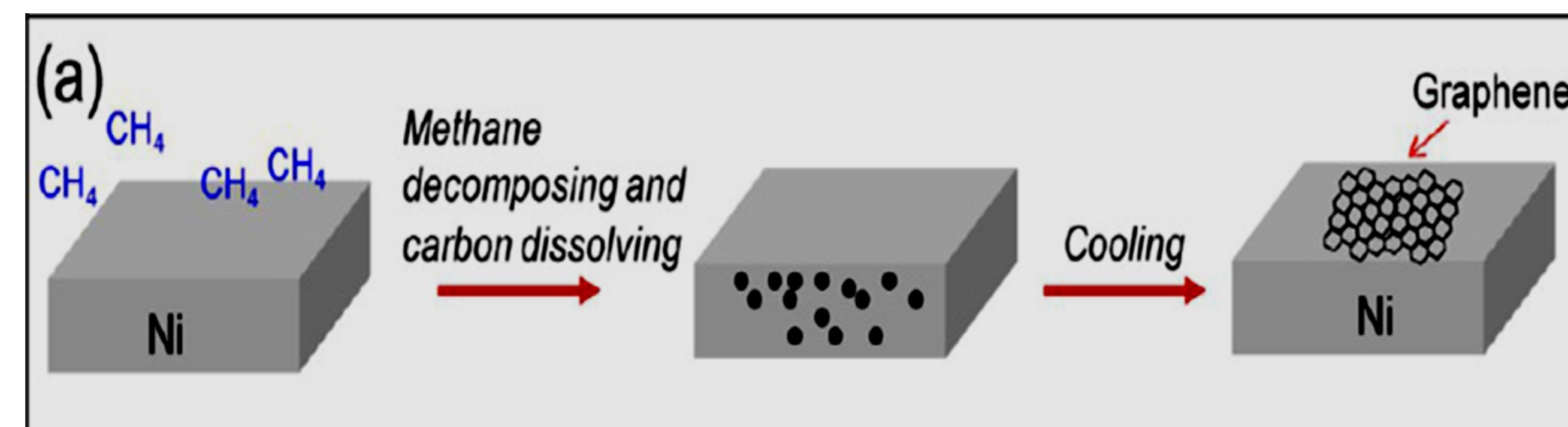


Figure 2: CVD Process

<http://cnx.org/content/m43579/latest?collection=col10699/1.17>

- By adding graphene to the mixture of concrete, it will enhance its tensile and cohesive properties
- Sustainability will be achieved with Transparent graphene-based solar panels
- Graphene with the polymer PEDOT-PSS has photoelectric characteristics similar to platinum (Figure 3)

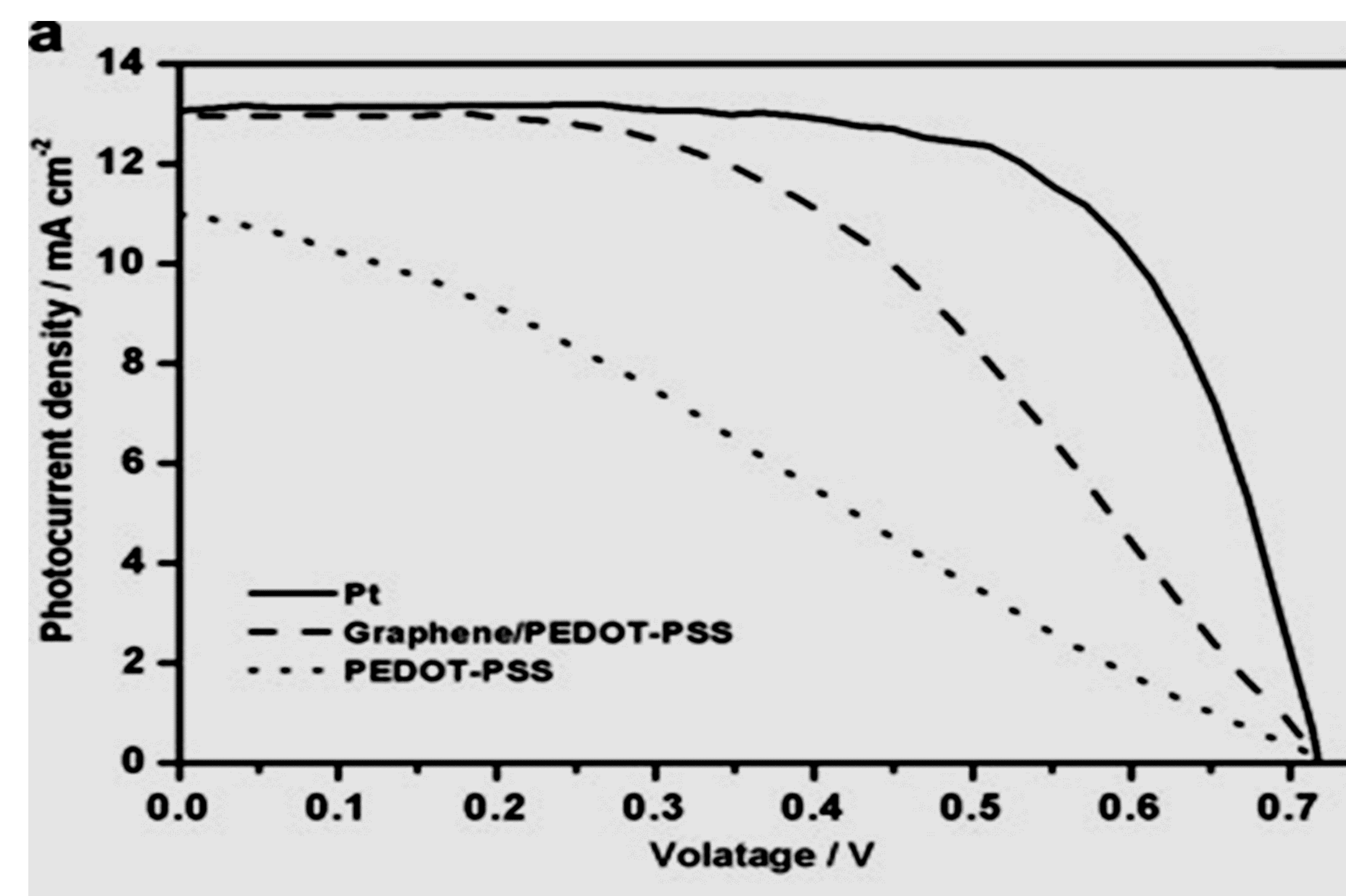


Figure 3: Platinum vs. Graphene

<http://www.sciencedirect.com.ezproxy.aus.edu>

- Layering graphene into a mesh which creates band gaps; the process still needs a lot of research in order to be effective

## Evaluation

- Low cost and large scale production of graphene can be achieved with CVD
- The engineering building will utilize graphene in its construction for added tensile and cohesive properties (Table 1)

Graphene, %	Water : cement ratio	Cement weight, (g)	Water weight, (g)	GO weight, (g)	Sand weight, (g)	Additive weight, (g)	Total weight, (g)	Tensile Strength (MPa)
0	0.4	147.56	59.02	0.00	442.68	0.74	650	2.55
0.1	0.4	147.51	59.06	0.15	442.54	0.74	650	2.76
0.3	0.4	147.42	59.14	0.44	442.26	0.74	650	3.04
0.5	0.4	147.33	59.22	0.74	441.98	0.74	650	3.43
1	0.4	147.09	59.43	1.47	441.28	0.74	650	3.75
1.5	0.4	146.86	59.62	2.20	440.58	0.73	650	3.99
2	0.4	146.63	59.82	2.93	439.88	0.73	650	2.26

Table 1: Tensile Strength of Graphene Samples

<http://www.hindawi.com/journals/tswj/2014/276323/>

- Renewable energy will be the major source of power for our building
- Increased efficiency for students and faculty members using integrated and connected computers
- The cost at the moment is very high, but like all new materials its price will also decrease (Figure 4)

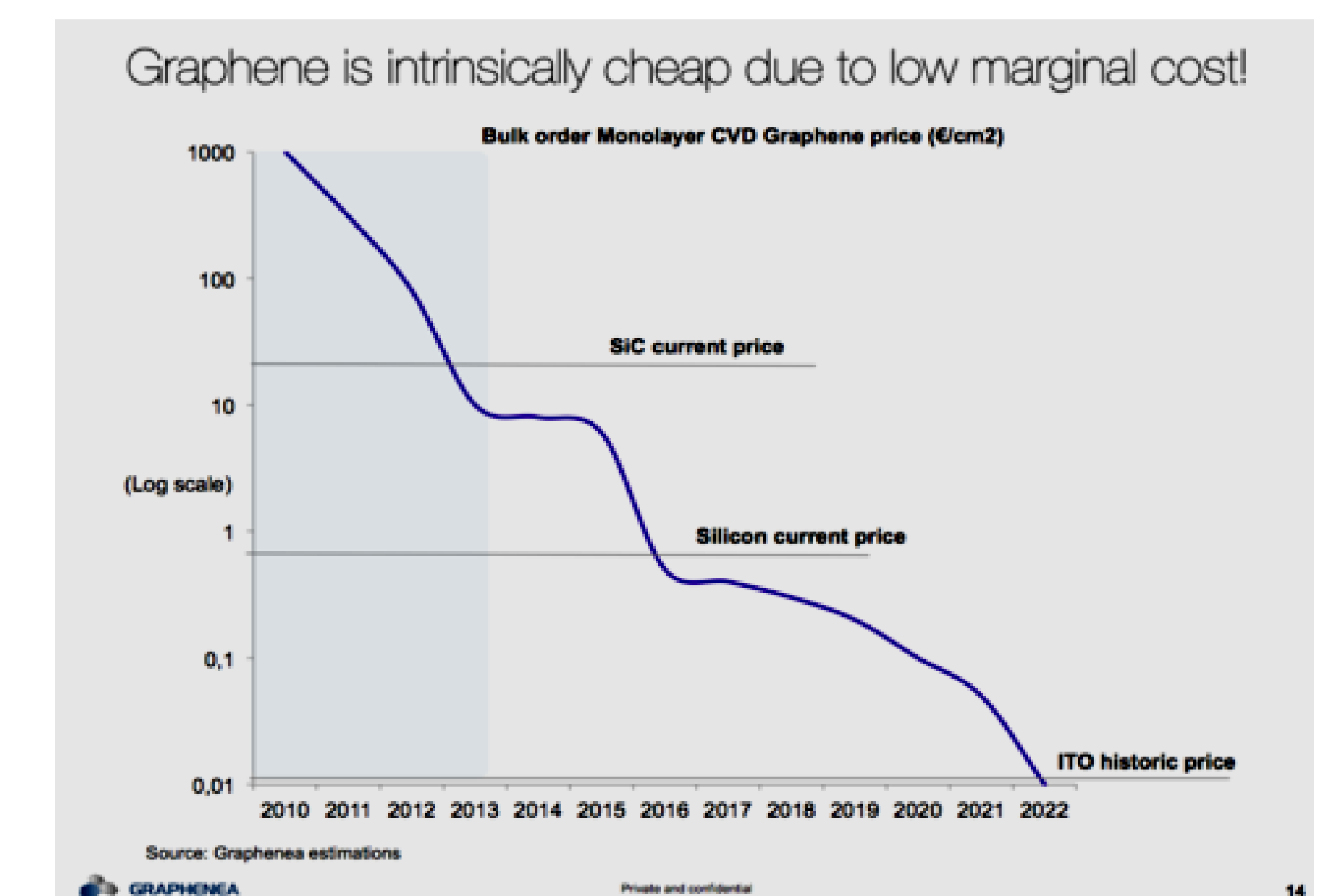


Figure 4: Cost of Graphene

<http://www.graphenea.com/pages/graphene-price#.UJcKZpZq1s>

### References

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