

# NANO - Role Play

## Revolution for the light bulb

Only 5-10% of the energy used within an incandescent light bulb actually creates the light, the other 90% is wasted on heat. That's why you burn your fingers when you touch an operating light bulb! About 20% of the electric power consumed in the world is used to generate light. There would be a significant reduction in power consumption and thus CO<sub>2</sub> emissions if less energy was wasted. One way to do this is to create new sources of lighting which use significantly less power to operate. Light Emitting Devices (LEDs) have been developed to fulfil this need, but the current technology suffers some limitations in terms of lifetime of the device and the capacity to display a true "white" colour. One proposed solution

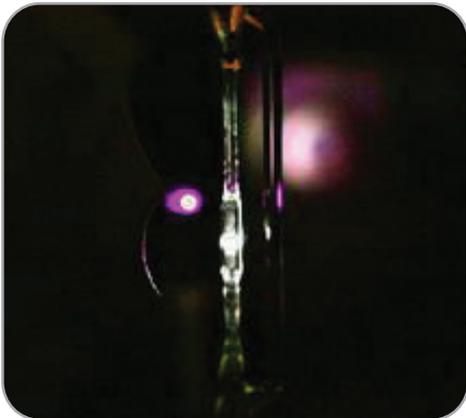


Image above: Quantum dots produce white light when stimulated by an ultraviolet laser beam. Photo by Daniel Dubois

is to use a mixture of semiconductor nanocrystals, also called "quantum dots", as the intrinsic emitting layer of a LED device. Quantum dots are characterized by emitting saturated and monochromatic light; the colour emitted depends on the size of the QD and the light is emitted under certain conditions, e.g. when current passes to them via conductive polymer films.

Recently even white-emitting quantum dots have also been fabricated. Therefore quantum-dot based LEDs are promising light sources and for use in flat-panel displays.

To stabilize quantum dots they are "entrapped" in polymer composites, which also will enable using them in panels and other hybrid devices. Like other materials used in electronics (e.g., transistors), quantum dots are often made of toxic metals like cadmium, although in extremely small amounts. Therefore QD-LEDs would need to be properly managed once disposed of, as is the case for all electronics. However, as quantum dots are so small, it could be problematic to separate them from the polymer composite, to which they are intimately bonded. Also, if disposed improperly, they could represent an environmental hazard once they fully decompose.

### The Dilemma :

**Do we implement the quantum dot technology within an energy efficient light source even though some health and environmental risks remain unanswered?**

**The Dilemma :**

**Do we implement the quantum dot technology for energy efficient light source even though some health and environmental risks remain unanswered?**

**Stakeholders: Scientist**

You represent the community of scientists and researchers in the nano-science and nanotechnology field.

Your primary motivations are:

- To seek knowledge and understanding on the atomic and molecular level of materials
- To control matter on an atomic and molecular level
- To create many new materials and devices with wide-ranging applications, such as energy production

Consider the following:

- Quantum dots have unique physical properties due to their size and shape.
- The properties of quantum dots can be altered purely by changing their size.
- QDs can be made from non-heavy metals too, though they may not be as useful.
- Toxic materials are already used in electronic devices which can be bought in the shops e.g. batteries, mobile phones. There are already regulatory mechanisms in place for their disposal.
- Quantum dots can be used in other fields. These include, but are not limited to, efficient solar power, targeted gene and drug delivery, solid-state lighting and advances in biomedical imaging.

**• Share your opinions with the group**

I think.....

• Note: You may come up with additional ideas, do not feel limited by the information above.

**The Dilemma:**

**Do we implement the quantum dot technology for energy efficient light source even though some health and environmental risks remain unanswered?**

**Stakeholders: Consumer**

You represent the consumers seeking for a reliable safe product.

Your primary motivations are:

- Have access to products with lower cost.
- Make sure that you get a cost – effective product
- Have efficient and reliable products

Consider the following:

- Reducing the electricity bill.
  - Reducing the global warming.
  - There are already regulations for the disposal of electronic devices.
  - Other possibilities to save energy.
  - Proper government regulations on recycling this product will reduce risks.
- As a consumer I have a responsibility to follow these regulations.

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**Stakeholders: Government**

You represent the government which can make and enforce laws for preventing certain uses of QD-LEDs and, on the other hand, fund agencies and universities research in order to understand the benefits and risks of using QD-LEDs.

Your primary motivations are:

- Reduction in power consumption.
- Protect the citizens from harm and pollution.
- Promote science and technology innovation to facilitate industrial growth which is essential for any prosperous nation.

Consider the following:

- We obviously are interested in any method which can reduce CO<sub>2</sub> emissions, but not at any cost.
- If products aren't disposed of safely, they can eventually release their chemicals into the environment. This problem applies to a lot of materials (laptops, batteries, refrigerators) and we already have in place regulations to deal with this issue. We will have regulations also for QD-LEDs.
- We will continue funding research programs to study the health and environmental safety of these nanomaterials, and will inform consumers if any unwanted effect is found, and take action accordingly.

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**Stakeholders: Device Manufacturer**

You represent a company that has developed the QD-LED and is seeking to begin using them.

Your primary motivations are:

- To provide a valuable product to consumers.
- To generate profit for company.

Consider the following:

- The technology we developed provides over 80% energy saving and lasts up to 25 times longer than lighting alternatives currently available.
- If the products aren't disposed of safely, they may eventually release nano particles into the environment. However waste management is the responsibility of the consumer and of the local municipalities.

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**Stakeholders: The Environmentalist**

You represent the agencies and groups seeking to provide the best outcomes for the human and natural environments both now and into the indefinite future.

Your primary motivations are:

- Maximize the use of electric power generated by sustainable, economic, and environmentally acceptable technology.
- Provide a long-term commitment to energy research and development.

Consider the following:

- If the products aren't disposed of safely, they may eventually release nanoparticles into the environment
- This technology provides over 80% energy savings and lasts up to 25 times longer than lighting alternatives currently available.
- We just don't know enough about whether nano-sized particles are more toxic than materials in the bulk.
- We should concentrate on using renewable energy sources, like wind energy.

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**The Dilemma:**

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**Stakeholder: Child (you)**

What is your opinion?