

# California Energy Commission

## October 11, 2012

California Energy Commission
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# Outline

- Background
- CRI>90 is good CRI=80 is not
- Opposing views arise from misunderstanding
- CRI>90 saves energy and is good for people

# Background

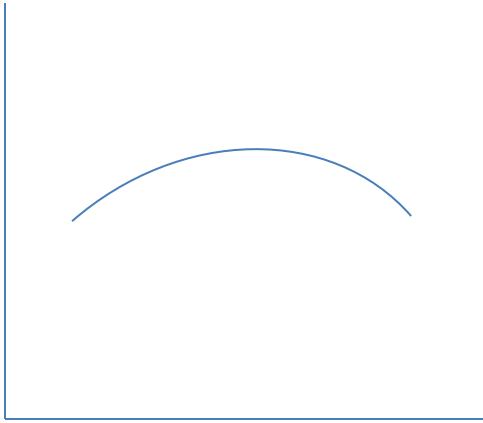
- My background is in Physics & Psychology & Business – all three needed to understand the issue with CRI.
- I have no commercial interest in this matter.
- There is a need to uphold scientific standards of debate – many do not understand the full picture and/or have short sighted goals that conflict with the greater good.

# Unsupported Quotes

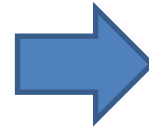
- *“Ordinary people simply don’t want or need a CRI of more than 80.”*
- This person did not know what CRI is and had no source for this incorrect view.
- *“We have an energy crisis. We simply can’t afford a CRI in excess of 80.”*
- This person did not know that a CRI of 90 will actually save energy.

# Color Rendering Put Very Simply

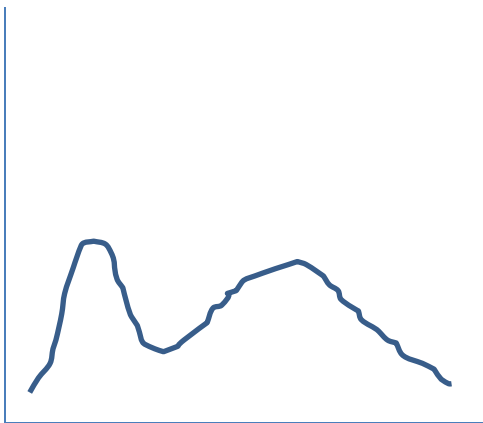
(reality is slightly more complicated, but this is the general conclusion)



Natural  
Smooth  
Spectra



Natural  
Pure  
Colors



Unnatural  
Crooked  
Spectra



Distorted  
Crooked  
Colors



# Simple Choice, Easy Answer

Consider Same Power in Two Different Lamps:

Choice A: 800 lumens @ CRI >90

vs.

Choice B: 900 lumens @ CRI 80

No one who fully understands the physics, psychology and economic issues favors B.

Choice A is unambiguously better.

CRI>90 is the clear and obvious best choice.

## Submission to California Energy Commission

Lorne Whitehead, Professor of Physics, University of British Columbia and Board Member,  
Commission Internationale de l'Eclairage

October 11, 2012

### Common False Arguments Against Above 90 Color Rendering For Household Lamps and Rebuttals

1. Requiring CRI 90 will waste energy and we can't afford that.

Not true. We can actually keep the energy use fixed and the resultant light will provide better vision. It will produce slightly fewer lumens (maybe 10% less), but that's no problem – it's well known that lumens do not measure the usefulness of light. In other words, better light has more value per lumen.

2. Natural color is a meaningless idea because the color of natural day light varies a lot.

Actually, the color appearance of *objects* illuminated with natural light is very stable because the human visual system adapts to overall color shifts of the illuminant as long as the color rendering is high, which it is for *all* natural phases of daylight.

3. Many people won't notice the color distortion with CRI 80, so why bother going to CRI 90?

This is no way to set a standard! First of all, most people will notice the distortion if there is a side-by-side test and they are asked to look carefully. And even if they do not consciously notice the distortion, they may be bothered by it. The standards we have for windows, for example, is that there should be no visible distortion, and the standards for floors is there should be no visible tilt. Why should our standards for one of our most powerful senses – color – be any less?

4. At CRI80, you can easily identify the basic colors red, orange, yellow, green, blue, etc. – who needs anything better than that?

Actually, the human color perception system evolved mainly to make much more subtle color distinctions – judging health by observing skin tones, judging the quality of food by its color appearance, etc. – and in modern times this has led to a gigantic aesthetic industry based on the subtleties and beauty of color and color combinations. Why would we want to needlessly impair such an incredibly important part of human life?

5. Color rendering is hard to understand, and not everyone agrees it is important, so until everyone agrees, wouldn't it be prudent to ere on the side of cheaper light, rather than better color?

That's not a prudent approach for matters of health and well-being. In such cases, it is prudent not to interfere with nature unless you have proof that it's OK to do so. Light is a human consumable, like food. Illuminating a space with light that distorts color is like polluting our

food – if we are going to do it, we should have solid scientific proof there is no harm. In the absence of such proof, and given there's an easy alternative, we just shouldn't do it.

6. When we were in school, we were often quite pleased if we got a grade of 80 out of 100. Why isn't that good enough for CRI?

Actually, the CRI score is not a score "out of" 100 and a score of 80 is not good at all. For CRI, the difference from 100 tells us how *bad* the color errors are with an unnatural light spectrum. An 80 CRI lamp has 20 units of needless color distortion, which is readily apparent. So in a very real sense, for CRI, 80 means failure. That's because most people can readily see that the color of many objects is distorted by such unnatural light. And when they realize that, they find it disturbing and weird.

7. But surely only a few experts need good color rendering, such as surgeons and butchers, artists and scientists. Can't the rest of us get by with less perfect color?

It turns out that ordinary people make extraordinarily precise color judgments all the time – when we look at a sick child's complexion and decide whether or not to visit the doctor, when we look at a banana and decide from its color whether it is ripe, when we suspect that a food item is no longer fresh, or when we choose a paint color for our home, we are often as sensitive as the best artist. And we have more at stake – our health!

8. If you read the literature on color, you find many complex theories and it sounds like the experts don't all agree, so until they do, isn't it better to just stick with CRI 80?

In science, there are always experts who enjoy studying and arguing about complex matters. In comparison, what we're talking about is simple and straightforward – we should just stop needlessly, obviously, distorting color. Anyone can tell when spectra are correct so they no longer distort color. It's just a matter of saying no. That's what CRI>90 is about.

9. But won't CRI above 90 just cost too much money?

No it won't. In the past, before LED's, that might have been a slight issue, but not today. Numerous manufacturers are already making CRI>90 products. Yes, it does cost just a little more to get the spectrum right. This means that today, when CRI 80 is allowed, competition forces volume manufacturers to go to that lowest common denominator. Therefore, that's where the volume is, and it is mainly that volume pricing that makes the CRI 80 products cheaper. But if we incentivise CRI>90, manufacturers will easily be able to adapt and in volume the cost will be essentially unchanged. What will be very different is that CRI>90 products will be more strongly embraced as a replacement for all forms of incandescent lamps.



## **Submission to California Energy Commission**

**Lorne Whitehead, Professor of Physics, University of British Columbia and  
Board Member, Commission Internationale de l'Eclairage**

**October 11, 2012**

**Rebuttal to the remarks made at the October 11, 2012 meeting that purportedly represented the views of Philips Corporation.**

At the October 11, 2012 public meeting of California Energy Commission, a presentation was made by a representation of Philips Corporation, which purportedly summarized the views of that company as a whole. (No evidence was provided to verify that these were indeed the views of the corporation as a whole.) The following is a brief summary of some of the points made in that presentation, and each is followed by a simple argument completely negates it.

### **1) "The proposed goal of 90 for CRI will lead to high cost."**

No evidence was provided to support the claim that a high volume product with a CRI of 90 will be problematically expensive. Already smaller manufacturers are selling lamps of that quality, and their cost is acceptable for many applications. History has shown time and time again that in high volume, cost will not be a problem.

### **2) "Before setting a goal of 90 for CRI, a great deal of research should be carried out over a long time to prove, beyond doubt, that a lower value of CRI is less desirable for consumers."**

This is an obvious and misguided delay tactic. It is well known that light affects health. Light with a low CRI is unnatural and quite possibly unhealthy, if for no other reason because perceptual distortion often makes people feel uncomfortable. In matters of health, if there is a proposal to expose people to an unnatural radiation or chemical, the burden of proof must be on the proponent to prove safety, and until then it should be discouraged. In this case, it means the appropriate stance is to recommend a CRI of 90, as a prudent and responsible health measure.

### **3) "It has been claimed that in California many customers were dissatisfied with the color quality of CRI 80 CFL lamps promoted by a rebate program. But in reality many of the lamps were not Energy Star products and their CRIs were about 65."**

A knowledgeable utility representative at the meeting spoke shortly a bit later and clearly stated that this claim is false. All of the lamps in question were Energy Star products with a CRI of 80.

**4) To achieve the same luminous flux with a CRI of 90, rather than 80, will require 10 to 15 % more power and electrical usage will increase by that percentage.**

It is true that efficacy will drop a bit, but the claim that power use will rise is false for two different reasons:

First, there is no requirement to have a lamp with CRI of 90 have the same luminous flux as a lamp with CRI 80. When the CRI is higher, people see better and are satisfied with 10 to 15 % fewer lumens. In fact, given the choice, almost everyone would prefer to have a CRI of 90 and 10 to 15 % fewer lumens. Such a lumen reduction is essentially invisible, but the difference in color quality is readily apparent when viewing numerous common objects.

Second, by far the most important factor for energy savings is that incandescent lamps get replaced. A replacement lamp that achieves comparable color (as with CRI 90) is far more likely to be installed more broadly in homes and thus much more energy will be saved.

**5) “Recently Philips sold two LED products side by side in stores. They were very similar in every way but CRI and price. One had a CRI of 90 and cost more and the other had a CRI of 80 and cost less. The vast majority of customers purchased the CRI 80 product, which proves that the consumer accepts a CRI of 80 and does not need a CRI of 90.”**

This argument is disturbingly vacuous. A negligible fraction of customers understand the meaning of the CRI rating on a package, and the purchasing environment of a store offers no opportunity to actually experience the color rendering quality of the light. Of course under such circumstances most customers would buy the cheaper product – this observation provides no information at all about actual consumer preference.

Furthermore, consumer preference is not necessarily even the most correct guide. Taking another health example, consumers never had any difficulty with the taste or texture of trans-fats. But the fact is that trans-fats are not good for people, which is why steps are being taken to eliminate them from human diet. Similarly, it is now practical to avoid unnatural color-distorting electric lighting, which will likely be better for human well-being and will certainly save energy. Therefore it is time to do so.