January 31, 2011

To:

Susan Hackwood, Ph.D.
Executive Director
California Council on Science and Technology

c/o: Lora Lee Martin, Director
Strategic Policy Initiatives and Government Affairs
California Council on Science and Technology

Re: CCST Smart Meter Report, issued January 11, 2011

Dear Dr. Hackwood and Ms. Martin,

This letter is meant to comment on CCST's Smart Meter Report, the conclusions with which we disagree. We also think the report lacks the scientific expertise and details to warrant serious consideration by those knowledgeable in this area of inquiry. The report reflects basic flaws in review perspective as well as simple factual errors that should never appear in a report such as this.

The basic question of whether the FCC's guidelines for radiofrequency radiation (RFR) exposure are met by smart meters is fundamentally beside the point regarding the task at hand required from CCST. Those guidelines in their current form are not sufficiently protective of human health, and likely never were. The present guidelines are obsolete, in need of substantive revision in both content and focus, and should be updated using far more recent research data. CCST had an opportunity to delve deeper into a potentially looming public health problem regarding the smart meter/grid buildout but unfortunately chose otherwise.

The FCC guidelines for the specific absorption rate (SAR) are based on narrow data from one set of experiments carried out in the 1980's (1, 2) which showed behavioral disruption in animals after exposure to RFR at a whole body specific absorption rate (SAR) of 4 W/kg. These studies have not been independently replicated yet are enshrined in the standards. Many other experiments since then have shown behavioral effects in animals at a SAR lower than 4 W/kg but no changes to the guidelines have been made (3).

It is misleading to discuss the guidelines based on thermal v. non-thermal effects. It is very difficult to scientifically differentiate between RFR-induced thermal and non-thermal biological effects. An increase in temperature does not necessarily, or automatically, imply that an effect being observed is thermal in nature only. Guidelines should be based on the exposure levels (SAR or power density) at which biological effects have been observed.

Examples of factual errors in the report include:

- In Fig 5, the vertical bar at around 900 MHz gives the power density of the maximum exposure from smart meters at 5%, 50%, 100% duty cycles, i.e., when the meter is on 5%, 50% and 100% of the time. The power density (which is the unit of the vertical y-axis) is shown to increase with increase in the duty cycle. This is inaccurate. Power density is a measure of the strength of the RFR field at a certain time point and it should not change with the time of measurement. An analogy would be when a car runs at a constant speed of 50 mph, the speed remains the same no matter how long one measures it. In that analogy, what Figure 5 says is that a car would be running at 50 mph when measured for a duration of 5 minutes; but at 500 mph when measured for 50 minutes; and at 5000 mph when measured for 500 minutes.
- This also applies to Figure 7 with the statement 'smart meter figures represent 100% duty cycle' (i.e., always on) as a hypothetical maximum use case' simply does not make sense at all.

In a recent paper that we published in *Environmental Reviews* (4), one of the publications of Canada's National Research Council Press, we included a chart of 59 peer-reviewed studies showing various biological effects at low intensity RFR exposures (See attached chart below). Some of the works cited certainly apply to even the lowest intermittent exposures associated with smart meters. Smart meters therefore cannot be considered benign, despite adherence to FCC guidelines. The listed exposure levels at which biological/health effects have been observed are much lower than the FCC's 4 W/kg, and actually include levels that one would encounter in modern urban environments today.

Furthermore, exposure to smart meter RFR is chronic and unavoidable. There is not much data on the biological effects of chronic RFR exposure, although some does exist. There are research data showing that the effects of chronic low level exposures are different than those of acute short-term exposure such as the FCC guidelines. In fact, another set of similar experiments (5, 6) was carried out also in the 1980's to study the effects of repeated RFR exposures. The researchers concluded:

> "…the threshold for behavioral and physiological effects of chronic *(long-term)* RFR exposure in the rat occurs between 0.5 mW/cm^2 **(0.14 W/kg)** and 2.5 mW/cm^2 **(0.7 W/kg)**."

It appears that chronic exposure sensitized the animals to RFR. Thus, it is definitely insufficient to apply a guideline based on acute exposure to a chronic exposure situation such as would be experienced with smart grid/meter technology.

Another important question is whether RFR biological effects are cumulative? This applies to the discussion of smart meter duty cycles in the CCST report. There are some studies indicating that RFR effects can accumulate with repeated exposures (3). This is an important consideration in light of so many wireless devices in our midst today.

No agency takes cumulative exposures into consideration. Each device or new technology is considered a stand-alone. Most low-level RFR technologies are categorically excluded from FCC licensing or review if they meet certain exposure thresholds. Therefore, today's true exposures are unknown. What is certain, however, is that smart grid/meters will add a whole new layer of involuntary exposures to an ever-increasing background level of RFR.

An important missed opportunity in the report was a thorough discussion of the RFR emissions from 'access points' in the larger grid network. These points have significantly higher duty cycles in order to co-ordinate the signals from thousands of meters. In the very least, CCST should call for a cessation of the smart meter buildout until the emission levels from access points are known, setbacks are recommended from nearby residences, and a better assessment of cumulative exposures from meters, access points, and wireless components placed on or in appliances themselves can be determined. We recommend that CCST also advise the California legislature that more extensive assessment is needed regarding this technology before the state proceeds further.

One final comment… Neither California nor CCST is constrained by the preemptive language of the Telecommunications Act of 1996 regarding cell tower placement, which stipulates that municipalities/states cannot take the "environmental effects of radiofrequency radiation" into consideration "to the extent" that such facilities comply with the FCC guidelines for RFR emissions. The state and CCST are actually in a position to arbitrate the science regarding the safety of smart grids/meters and to make recommendations beyond the FCC guidelines. Unfortunately, CCST failed to step up in a meaningful way.

We hope you will go back to the drawing board, broaden your scope of inquiry, and extend your search into the literature of low-level effects. There is ample evidence for a more cautionary approach.

Respectfully Submitted,

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Table I. A list of studies reporting biological effects at low intensities of RFR. These papers gave either SAR (W/kg) or power density ($\mu W/cm^2$) of exposure.

		SAR (W/kg)	Power density ($\mu W/cm^2$)	Effects reported
Belyaev et al. (2005) (in vitro)	915 MHz, GSM 24 & 48 hr	0.037		Genetic changes in human white blood cells
Belyaev et al. (2009) (in vitro)	915 MHz, 1947 MHz GSM, UMTS 24 & 72 hr	0.037		DNA repair mechanism in human white blood cells
Blackman et al. (1980) (in vitro)	50 MHz, AM at 16 Hz	0.0014		Calcium in forebrain of chickens
Boscol et al. (2001) (in vivo) (human whole body)	500 KHz-3 GHz, TV broadcast		0.5	Immunological system in women
Campisi et al. (2010) (in vitro)	900 MHz, CW or 50-Hz AM, 14 days, 5, 10, 20 min per day, CW- no effect		26	DNA damage in human glial cells
Capri et al. (2004) (in vitro)	900 MHz, GSM 1 hr/day, 3 days	0.07		A slight decrease in cell proliferation when human immune cells were stimulated with mitogen and a slight increase in the number of cells with altered distribution of phosphatidylserine across the membrane.
Chiang et al. (1989) (in vivo) (human whole body)	People lived close to AM radio and radar installations for more than one year		10	People lived and worked near AM radio antennae and radar installations showed deficits in psychological and short-term memory tests.
De Pomerai et al. (2003) (in vitro)	1 GHz 24 & 48 hr	0.015		Protein damages
D'Inzeo et al. (1988) (in vitro)	10.75 GHz CW 30-120 sec	0.008		Operation of acetylcholine-related ion-channels in cells. These channels play important roles in physiological and behavioral functions.
Dutta et al. (1984) (in vitro)	915 MHz, sinusoidal AM at 16 Hz	0.05		Increase in calcium efflux in brain cancer cells.
Dutta et al.	147 MHz,	0.005		Increase in calcium efflux in brain cancer cells.

(1989) (in vitro)	sinusoidal AM at 16 Hz 30 min			
Fesenko et al. (1999) (in vivo) (mouse-wavelength in mm range)	From 8.15 - 18 GHz 5 hr to 7 days direction of response depended on exposure duration		1	Change in immunological functions.
Forgacs et al. (2006) (in vivo) (mouse whole body)	1800 MHz, GSM- 217 Hz pulses, 576 μs pulse width; 2hr/day, 10 days	0.018		Increase in serum testosterone.
Guler et al. (2010) (In vivo) (rabbit whole body)	1800 MHz AM at 217 Hz, 15 min/day, 7 days		52	Oxidative lipid and DNA damages in the brain of pregnant rabbits
Hjollund et al. (1997) (in vivo) (human partial or whole body)	Military radars		10	Sperm counts of Danish military personnel, who operated mobile ground-to-air missile units that use several RFR emitting radar systems, were significantly lower compared to references.
Ivaschuk et al. (1999) (in vitro)	836.55 MHz, TDMA 20 min	0.026		A gene related to cancer.
Jech et al. (2001) (in vivo) (human partial body exposure- not included)	900 MHz, GSM-217 Hz pulses, 577 μs pulse width; 45 min; narcoleptic patients	0.06		Improved cognitive functions.
Kesari and Behari (2009a) (in vivo) (rat whole body)	50 GHz; 2hr/day, 45 days	0.0008		Double strand DNA breaks observed in brain cells
Kesari and Behari (2009b) (in vivo) (rat whole body)	50 GHz; 2hr/day, 45 days	0.0008		Reproductive system of male rats
Kesari et al. (2010) (in vivo) (rat whole body)	2450 MHz, 50-Hz modulation, 2 h/day, 35 days	0.11		DNA double strand breaks in brain cells.
Kwee et al.	960 MHz, GSM	0.0021		Increased stress protein in human epithelial

(2001) (in vitro)	20 min			amnion cells.
Lebedeva et al. (2000) (in vivo) (human partial body)	902.4 MHz, GSM 20 min		60	Brain wave activation.
Lerchl et al. (2008) (in vivo) (hamster whole body)	383 MHz (TETRA), 900 and 1800 MHz (GSM) 24 hr/day, 60 days	0.08		Metabolic changes.
Magras and Xenos (1999) (in vivo) (mouse whole body)	'Antenna park'-TV and FM-radio, Exposure over several generations		0.168	Decrease in reproductive function.
Makova et al. (2005) (in vitro)	915 and 905 MHz, GSM 1 hr	0.037		Chromatin conformation in human white blood cells.
Mann et al. (1998) (in vivo) (human whole body)	900 MHz GSM pulse-modulated at 217 Hz, 577 μs width, 8 hr		20	A transient increase in blood cortisol.
Marinelli et al. (2004) (in vitro)	900 MHz CW 2 - 48 hr	0.0035		Cell's self-defense responses triggered by DNA damage.
Navakatikian and Tomashevskaya (1994) (in vivo) (rat whole body)	2450 MHz CW and 3000 MHz pulse-modulated 2 μs pulses at 400 Hz Single (0.5-12hr) or repeated (15-60 days, 7-12 hr/day) exppsure, CW-no effect	0.0027		Behavioral and endocrine changes, and decreases in blood concentrations of testosterone and insulin.
Nittby et al. (2007) (in vivo) (rat whole body)	900 MHz GSM 2hr/wk, 55wk	0.0006		Reduced memory functions.
Novoselova et al. (1999) (in vivo) (mouse whole body-wavelength in mm range)	From 8.15 -18 GHz, 1 sec sweep time-16 ms reverse, 5 hr		1	Functions of the immune system.
Novoselova et al.	From 8.15 -18		1	Decreased tumor growth rate and enhanced

(2004) (in vivo) (mouse whole body- wavelength in mm range)	GHz, 1 sec sweep time-16 ms reverse, 1. 5 hr/day, 30 days			survival.
Pavicic et al. (2008) (in vitro)	864 and 935 MHz, CW, 1-3 hrs	0.08		Growth affected in Chinese hamster V79 cells.
Panagopoulos et al. (2010) (in vivo) (fly whole body)	GSM 900 and 1800 6 min/day, 5 days		1 - 10	Reproductive capacity and induced cell death.
Panagopoulos and Margaritis (2010a) (in vivo) (fly whole body)	GSM 900 and 1800 6 min/day, 5 days		10	'Window' effect of GSM radiation on reproductive capacity and cell death.
Panagopoulos and Margaritis (2010b) (in vivo) (fly whole body)	GSM 900 and 1800 1- 21 min/day, 5 days		10	Reproductive capacity of the fly decreased linearly with increased duration of exposure.
Pérez-Castejón et al. (2009) (in vitro)	9.6 GHz , 90% AM, 24 hrs	0.0004		Increased proliferation rate in human astrocytoma cancer cells.
Perssson et al. (1997) (in vivo) (mouse whole body)	915 MHz-CW and pulse-modulated (217-Hz, 0.57 ms; 50-Hz, 6.6 ms) 2-960 min; CW more potent	0.0004		Increase in permeability of the blood-brain barrier.
Phillips et al. (1998) (in vitro)	813.5625 MHz (iDEN); 836.55 MHz (TDMA) 2 hr and 21 hr	0.0024		DNA damage in human leukemia cells.
Polonga-Moraru et al. (2002) (in vitro)	2.45 GHz 1hr		15	Change in membrane of cells in the retina.
Pyrpasopoulou et al. (2004) (in vivo) (rat whole body)	9.4 GHz GSM (50 Hz pulses, 20 μs pulse length) 1-7 days postcoitum	0.0005		Exposure during early gestation affected kidney development.
Roux et al. (2008a) (in vivo) (tomato whole body)	900 MHz		7	Gene expression and energy metabolism.

Roux et al. (2008b) (in vivo) (plant whole body)	900 MHz		7	Energy metabolism.
Salford et al. (2003) (in vivo) (rat whole body)	915 MHz GSM 2 hr	0.02		Nerve cell damage in brain.
Sarimov et al. (2004) (in vitro)	895-915 MHz GSM 30 min	0.0054		Human lymphocyte chromatin affected similar to stress response.
Schwartz et al. (1990) (in vitro)	240 MHz-CW and sinusoidal modulation at 0.5 and 16 Hz, 30 min, effect only observed at 16-Hz modulation	0.00015		Calcium movement in the heart.
Schwarz et al. (2008) (in vitro)	1950 MHz UMTS 24 hr	0.05		Genes in human fibroblasts.
Somosy et al. (1991) (in vitro)	2.45 GHz, CW and 16 Hz square-modulation, modulated field more potent than CW	0.024		Molecular and structural changes in cells of mouse embryos.
Stagg et al. (1997) (in vitro)	836.55 MHz TDMA duty cycle 33% 24 hr	0.0059		Glioma cells showed significant increases in thymidine incorporation, which may be an indication of an increase in cell division.
Stankiewicz et al. (2006) (in vitro)	900 MHz GSM 217 Hz pulses-.577 ms width 15 min	0.024		Immune activities of human white blood cells.
Tattersall et al. (2001) (in vitro)	700 MHz CW, 5-15 min	0.0016		Function of the hippocampus.
Velizarov et al. (1999) (in vitro)	960 MHz GSM 217 Hz square-pulse, duty cycle 12% 30 min	0.000021		Decrease in proliferation of human epithelial amnion cells.
Veyret et al. (1991) (in vivo) (mouse whole	9.4 GHz 1 μs pulses at 1000 pps, also with or	0.015		Functions of the immune system.

body)	without sinusoidal AM between 14 and 41 MHz, response only with AM modulation, direction of response depended on AM frequency			
Vian et al. (2006) (in vivo) plant	900 MHz		7	Stress gene expression.
Wolke et al. (1996) (in vitro)	900, 1300, 1800 MHz, square-wave modulated at 217 Hz; Also 900 MHz with CW, 16 Hz, 50 Hz and 30 KHz modulations	0.001		Calcium concentration in heart muscle cells of guinea pig.
Yurekli et al. (2006) (in vivo) (rat whole body)	945 MHz GSM, 217 Hz pulse-modulation 7 hr/day, 8 days	0.0113		Free radical chemistry.