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TESTIMONY OF TRAVIS LONGCORE, PH.D.

My name is Travis Longcore. I have been retained to provide written and oral testimony on the biological impacts of the proposed Sunrise Powerlink Transmission Project with special emphasis on avian collision and electrocution and other impacts to birds. I am currently Research Assistant Professor of Geography at the University of Southern California Center for Sustainable Cities where I am Director of Urban Ecological Research. I am also Science Director of The Urban Wildlands Group, a Los Angeles-based conservation nonprofit. I have taught for seven years at UCLA for the Department of Geography, Institute of the Environment, and Department of Ecology and Evolutionary Biology. Courses taught include Environmental Impact Assessment, Bioresource Management, Ecology, and Field Ecology.

For the past ten years I have consulted on land use issues, providing expert opinion on the compliance of proposed projects with various laws, including the California Environmental Quality Act, National Environmental Policy Act, California Coastal Act, Endangered Species Act, and Migratory Bird Treaty Act. In this capacity I have reviewed dozens of environmental reports and evaluated the quality of their biological resources analysis. I have expertise in the scientific literature describing avian collisions with structures, particularly with lighted communication towers, but also with wind turbines and other structures. Further information about my background can be found in the attached curriculum vitae.

This testimony is based on the Draft Environmental Impact Report/Environmental Impact Statement and Proposed Land Use Plan Amendment (“DEIR/EIS”), peer-reviewed scientific articles that are cited herein, assumptions predicated on these sources, and expert opinion supported by these facts and assumptions.

Collision Impacts

The DEIR/EIS does not provide adequate data to describe and mitigate the impacts resulting from avian collisions with the proposed power transmission lines. Guidance for identifying and mitigating impacts from collisions is available (APLIC 1994) and the DEIR/EIS claims that the project will follow these guidelines in designing and siting towers. “The applicant shall install the transmission lines utilizing Avian Power Line Interaction Committee standards for collision-

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reducing techniques as outlined in ‘Mitigating Bird Collisions with Power Lines: The State of the Art in 1994’” (p. D.2-147). APLIC is a well-respected utility-supported organization that is run by the Edison Electric Institute, which is the research arm of the utilities. The authors of the APLIC guidelines include a U.S. Fish and Wildlife Service biologist, a respected ornithologist from Clemson University, and a retired electrical engineer from a utility company (APLIC 1994). They received input from a broad range of electric utility companies and the resulting guidelines are widely accepted by the industry. A comparison of these guidelines and the DEIR/EIS reveals, however, that these techniques have not been utilized in the siting and design of towers for this project.

It deserves mention that avian collisions with power lines can be reduced through tower design and siting decisions, but collisions cannot be eliminated (Alonso et al. 1994; Brown and Drewien 1995; Janss and Ferrer 1998). Even a single tower can kill many birds in a single night under adverse conditions, as was shown by a 100-foot unlighted communication tower on a ridge in West Virginia that killed 75 birds in a single night (Wylie 1977). This type of blind collision can occur during the day as well (Emerson 1904; Bevanger 1998; Janss 2000). Even after following all possible mitigation measures currently available, avian collisions will continue to occur with power lines. For this reason, site planning is critically important to minimize impacts of new routes. As summarized by Janss (2000), “Because mitigation measures only reduce collision mortality, but do not solve it, adequate route planning of power lines is especially important.”

APLIC (1994) provides the following guidance on route planning:

- Keep lines distant from areas where birds are taking off or landing (e.g., wetlands).
- Keep lines below the height of vegetation (in forests).
- Avoid topographic features that concentrate migratory birds (e.g., mountain passes, river valleys).
- Orient lines parallel to primary flight patterns.
- Minimize the horizontal distribution of lines by placing them all at the same height rather than stacked at different heights. This is especially important because the majority of collisions occur with the overhead ground wire, which is typically smaller than other wires and virtually invisible to birds in flight.

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Obviously a certain amount of field reconnaissance is necessary to gather the information needed to follow these guidelines. APLIC (1994) provides an entire chapter describing methods to observe birds in power line corridors and to evaluate the presence of birds for potential new corridors. They conclude:

“All items that could affect the success of the project must be considered and evaluated before the line is built. In general, the purpose of preconstruction studies is to obtain information on bird flight altitudes, directions of flight, intensity of movement, species composition, and temporal variations in flight activity in and about the corridor. Day-time and night-time observations should be made by individuals who can identify birds correctly and gather quantitative data in a systematic fashion” (APLIC 1994).

The DEIR/EIS, despite claiming to follow the APLIC guidelines as part of mitigation measure B-10a, does not show any evidence that project applicants have done so in planning the route and designing the towers.

Some effort is made in the DEIR/EIS to identify migratory pathways for birds. These pathways are shown on several figures (D.2-1, D.2-2, D.2-3). The source given for these pathways is two email communications between a staff member at the San Diego Natural History Museum and consultants for the proposed project (p. D.2-540). The applicant has an obligation under the APLIC guidelines to collect data regarding the distribution, behavior, species composition, and collision susceptibility of the birds that will encounter all portions of the proposed project. Unfortunately, the DEIR/EIS incorrectly claims that it is not possible to know how many birds or what species might be impacted by the proposed projects (D.2-146 and repeated several times thereafter). To the contrary, the APLIC guidelines identify many techniques to evaluate the bird use of areas in route planning. These include: daytime and nighttime visual observation using tools to measure distance and altitude of birds (clinometers and theodolites), closed circuit television recordings, night vision tools such as image intensifiers, forward looking infra-red devices, and radar. In fact, radar techniques were developed to detect birds specifically to evaluate the risk of new transmission lines in 1978 (Korschgen et al. 1984). These tools can be used to develop a reasonable assessment of the quantity and general species composition of birds that might be at risk of collision. Examples of such efforts are available in the published literature. Williams et

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al. (2001) used radar, visual observations, and a ceilometer to describe birds migrating through a mountain pass. Mabee and colleagues have described bird numbers and altitude of flight using radar at proposed wind power sites (Mabee and Cooper 2004; Mabee et al. 2006). Others have used nocturnal flight calls to identify passing migrants (Farnsworth et al. 2004; Farnsworth and Russell 2007).

It is common for energy projects that may impact migratory birds to include detailed studies of bird migration using a combination of visual observation and radar investigation as part of the environmental review process. The APLIC guidelines cite three such examples (James 1980; McKernan et al. 1982; Gauthreaux 1991). A cursory Internet search reveals many other examples of pre-construction monitoring of birds for potential impacts, including reference to a study of “bird migration in relationship to a proposed powerline and proposed mitigation” by the Golden Valley Electric Association in Alaska, and numerous studies of risk to birds from wind power projects (Mabee and Cooper 2004; Mabee et al. 2006). There are consulting firms that specialize in such studies, offering services such as “monitor rates of nocturnal and diurnal bird migration/movements” and “identify migration and movement corridors for birds” (www.abrinc.com). For projects with potential impacts from avian collision, fieldwork using radar and other techniques is common (Korschgen et al. 1984; Cooper et al. 1991; Harmata et al. 1999; Deng and Frederick 2001; Gauthreaux and Belser 2003; Mabee and Cooper 2004; Mabee et al. 2006).

Although the DEIR/EIS should rely on data gathered in the field at proposed transmission line sites to assess the collision risk of potential structures, it is remarkable that the DEIR/EIS contains no data from San Diego Gas & Electric regarding collisions (or electrocutions) of birds at existing high voltage transmission lines. Given the environmentally oriented operating procedures described in the DEIR/EIS, it would seem that SDG&E personnel would have collected data regarding collision events (incidental observations made by maintenance staff) or electrocution events resulting in power outages. Other utilities collect such data, especially on electrocutions, because they result in service interruptions (APLIC 1994, 2006). Although such data are rarely collected by systematic surveys, they would at least give an indication of the patterns of species vulnerability to collision and electrocution in the project area at existing transmission lines.

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Absent data from original studies or incidental observations from SDG&E at existing lines, potential mortality and vulnerable species must be discerned from the scientific literature. Although most migrants travel at altitudes greater than the tops of the proposed towers (Able 1970; Bellrose 1971), a certain proportion of migrants is found nearer the ground, especially during inclement weather or daytime migration (APLIC 1994). Mabee and Cooper (2004) found that at two locations in Oregon, 12–14% of spring migrants were flying below 100 m (328 feet). For a fall migration in West Virginia, 12.7% of birds flew below 100 m (Mabee et al. 2006). These studies show that at given times birds are migrating at an altitude where they could collide with powerlines (e.g., below 100 m).

Ornithologists have identified characteristics that make certain bird species especially vulnerable to collisions (Bevanger 1994; Savereno et al. 1996; Bevanger 1998; Janss 2000). Rails, coots, and cranes (Gruiformes) are most frequently recorded birds killed at powerlines (Bevanger 1998). Other groups at risk include waterbirds and diving birds such as ducks (Anseriformes) and loons (Gaviformes), which also have high “wing loading,” which means that their wings are small relative to their weight (Bevanger 1998). These species are unable to maneuver to avoid powerlines, especially in low visibility conditions. Many shorebirds (Scolopacidae) are collision victims, partially because they encounter many lines in their long migratory routes (Bevanger 1998). Aerial predators, such as swifts, many raptors, and even gulls, are at risk because they spend so much time in flight that they have an increased probability of colliding with wires than other species that fly less (Bevanger 1998; Janss 2000).

Collision mortality is of particular concern for species that are in decline (Bevanger 1998; Janss 2000). Usually such species are identified as “sensitive” or are formally listed as threatened or endangered species. For those bird species identified as sensitive in the DEIR/EIS, many fall into groups that are susceptible to collision with power lines. These include the raptors (Cooper’s hawk, golden eagle, long-eared owl, ferruginous hawk, Swainson’s hawk, northern harrier, white-tailed kite, prairie falcon, bald eagle), common loon, greater sandhill crane, least bittern, and long-billed curlew. Also at risk are all smaller migratory species, which are killed in collisions but are much more difficult to locate under wires than larger species.

The DEIR/EIS fails to recognize the hazard posed to resident and migratory birds of the Salton

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Sea and the agricultural fields to the south of it. The proposed northern route would pass along and through the western edge of the agricultural zone and within two miles of the Salton Sea itself. The agricultural fields are even more important than the Salton Sea itself to many wading birds (cattle egret, white-faced ibis, sandhill crane) and shorebirds (mountain plover, whimbrel, long-billed curlew) (Shuford et al. 2002), yet the DEIR/EIS does not recognize the increased risk of mortality posed by a new transmission line through this essential habitat. Furthermore, the DEIR/EIS does not identify the risk of constructing a power line across San Felipe Creek, less than 1.5 miles from wetland habitats on the southwestern edge of the Salton Sea. This area is identified as supporting particular concentrations of colonial waterbirds (Shuford et al. 2002). Because of the proximity to wetland habitats associated with the Salton Sea and the rather extensive marsh and stream habitats along San Felipe Creek and San Sebastian Marsh, birds can be expected to move between the Salton Sea and the San Sebastian Marsh. These will include members of the very groups of birds that are at high risk of collision with power lines. Indeed, the earliest records of power line mortalities are derived from exactly this situation, where power lines are located between and adjacent to wetland habitats (Emerson 1904).

The DEIR/EIS should consider impacts to sensitive bird species at the Salton Sea from collision with the Imperial Valley Link (Table 1). These species have morphological characteristics that predispose them to collisions with power lines (Bevanger 1998; Janss 2000) and the DEIR/EIS fails to identify many of them as being impacted by the proposed power line.

Table 1. Sensitive species associated with Salton Sea and agricultural lands (Shuford et al. 2002) that are vulnerable to collision with power lines (Emerson 1904; McNeil et al. 1985; Bevanger 1998; Janss 2000). Status is indicated as California Bird Species of Special Concern (BSSC), federal Birds of Conservation Concern (BCC), and listing status under state and federal endangered species acts.

Species	Status
brown pelican	Federally endangered
American white pelican	California BSSC, Federal BCC
American bittern	Federal BCC
least bittern	California BSSC, Federal BCC

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greater sandhill crane	California threatened, Fully Protected Species
lesser sandhill crane	California BSSC
white-faced ibis	Federal BCC
wood stork	California BSSC
fulvous whistling-duck	California BSSC
black rail	California Threatened, Federal BCC
Yuma clapper rail	Federal Endangered
greater sandhill crane	State Threatened, Fully Protected Species
long-billed curlew	Federal BCC

Collision with power lines is the principal cause of death for sandhill cranes (California Department of Fish and Game 1994), which are threatened and fully protected species in California. Collisions occur during migration and when power lines are found in feeding areas (Krapu et al. 1984; Windingstad 1988). The construction of major power lines within known feeding areas south of the Salton Sea would constitute a significant impact to sandhill cranes, which the DEIR/EIS overlooks entirely.

Part of the risk to waterfowl from power lines is that waterfowl rarely fly under power lines but rather attempt to gain altitude and fly over them (Morkill and Anderson 1991). This makes them vulnerable, especially when they see transmission lines and gain altitude, only to collide with the nearly invisible ground wire above the energized lines (Morkill and Anderson 1991). Marking ground wires is consequently a common mitigation technique (APLIC 1994; Brown and Drewien 1995; Janss and Ferrer 1998).

The proposed aboveground transmission line routes would be a permanent hazard to resident and migratory birds. Far greater field data must be conducted to describe this risk, but it is probably significant in most of the undeveloped regions of the project area. The proposed project design, as far as it is revealed in the DEIR/EIS, does not minimize those impacts, nor does it follow the APLIC recommendations to do so.

1. *Keep lines distant from areas where birds take off or land.* The Imperial Valley Link

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cuts through habitat highly utilized by wintering birds (agricultural lands) and between wetland habitats. The Anza-Borrego Link, Central Link, and Inland Valley Link traverse habitats where dense populations of birds live and through which many species migrate. No mitigation for the Imperial Valley Link is even proposed.

2. *Keep lines below the height of vegetation.* This minimization measure is not available for the proposed project because the vegetation types through which the lines would pass are not forested.
3. *Avoid topographic features that concentrate migratory birds.* Although the proposed routes do not follow ridgelines, they do follow valley floors, which can also concentrate migrants. Furthermore, no data were collected to describe the movement of birds across the various project areas so no conclusions can be reached whether migratory pathways have been avoided.
4. *Orient lines parallel to primary flight patterns.* No studies were conducted to determine these flight patterns, but the extent of the project guarantees that this recommendation cannot be followed throughout.
5. *Minimize horizontal distribution of lines.* The proposed project fails to follow this recommendation. The 500 kV tower design includes two ground wires at the top of the tower with the main circuits hanging below. In areas with the 69/92 kV underbuild the towers include three heights of wires spread over 60–70 feet (Figure B-19). All of the steel pole towers show circuits at several heights (B-16 to B-18) rather than at the same height. None of these designs are consistent with the APLIC (1994) recommendations because they spread the wires over a vertical area of 60–80 feet. If all cables were to be at one level, one change in altitude would allow birds to avoid them (Janss 2000). The current designs therefore do not minimize collision risk to birds.

Mitigation Measure B-10a further suggests the use of diversion devices for a portion of the project in the Imperial Valley and Anza-Borrego links. Diversion devices can reduce mortality of birds by 50% and sometimes 75% (Morkill and Anderson 1991; Alonso et al. 1994; Brown and Drewien 1995; Janss and Ferrer 1998). Such a reduction is an improvement, but certainly does

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not represent reduction of the significant impact to a less than significant level given the miles of lines to be installed and the vulnerable species known to live and migrate near these lines. Appropriate studies of these transmission corridors following the APLIC (1994) guidelines would allow for an adequate description of additional risk to birds from collisions with the proposed lines but these studies have not been conducted. Sufficient data are not presented in the DEIR/EIS to support the claim that impacts to birds from collision with the proposed transmission lines would be mitigated to a less than significant level and indeed, collisions could result in take of federal and state protected species.

Electrocution Impacts

Electrocution by power lines is a significant source of mortality for some bird species to the extent that population density and distribution is altered (Sergio et al. 2004). The DEIR/EIS describes a project that will consist of large transmission lines, while most mortality from electrocution derives from smaller distribution lines where the separation between wires is smaller (Lehman 2001; APLIC 2006). The proposed project also involves relocation of a 69 kV distribution line along the Central Link of the project (p. D.2-144). Although the DEIR/EIS argues that the electrocution risk will be the same as before, this relocation makes the relocated distribution line part of the project and therefore impacts must be identified, minimized, and mitigated. The project also does not fully account for the collision risk posed by the 69 or 92 kV underbuilds along several project links. The depictions of such structures (Figure B-19) do not provide measurements of the distances between the energized conductors and between the innermost conductor and the steel structure. The renderings are apparently not to scale, but it seems possible that the underbuild lines might be close enough to allow for electrocution of birds.

The DEIR/EIS does not discuss the potential of “streamers” to cause flashovers on power lines. “Streamers” are long streams of bird excrement that can span energized conductors and other line structures. A flashover is a fault that originates on the energized conductor and travels through the streamer to the structure (APLIC 2006). These may cause power outages and occasionally bird mortalities (APLIC 2006). The DEIR/EIS should discuss this potential problem relative to the tower designs proposed for the project.

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Transmission Towers as Perches

The construction of transmission towers across areas that have few natural perches can dramatically alter the distribution of raptors and ravens (Knight and Kawashima 1993; Knight et al. 1993). For example, a study of raptor habitat use and density following construction of a 230 kV transmission line with 75-foot towers across open prairie in Colorado showed a significant increase in raptor density within 1,300 feet (0.4 km) of the towers (Stahlecker 1978), essentially changing the distribution of raptors across the landscape. Although towers were 1.5% of the available perches, they accounted for 81% of raptor perch sites (Stahlecker 1978). Such artificial concentration of predaceous species by power lines has been confirmed in other studies (Knight and Kawashima 1993) can have adverse impacts on prey species (Lammers and Collopy 2007).

The DEIR/EIS acknowledges that transmission towers would provide additional nest sites for red-tailed hawks but asserts that the number of red-tailed hawks would be controlled by prey availability (p. D.2-148). This argument does not, however, account for the altered distribution of raptors within the landscape that results from transmission tower construction (Stahlecker 1978). This impact is in fact significant because of the concentration of predator activity in certain areas and its effects on sensitive species. The DEIR/EIS offers no mitigation for this impact.

The mitigation proposed for increased density of ravens associated with transmission towers is to develop a raven control plan for Anza-Borrego State Park and in habitat for desert tortoise and flat-tailed horned lizard (MM B-11a, b). Ongoing lethal control of ravens, as implied by the text of the mitigation measure, is far less desirable than avoiding such impacts. Undergrounding lines along existing roads would avoid this impact entirely.

Noise

The analysis in the DEIR/EIS of the impacts of increased noise from construction and operations on sensitive bird species relies on the faulty assumption that they are not affected by noise levels less than 60 dB(A). The DEIR/EIS applies this standard to least Bell's vireo, southwestern willow flycatcher, California gnatcatcher, and other species. Least Bell's vireo was located along the proposed route in the Anza Borrego Link (Yaqui Well) and Central Link (assumed present at MP 101), while southwestern willow flycatcher is assumed present along the Central Link (MP

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101). These species were located or assumed present along several of the alternative routes as well.

The 60 dB(A) threshold for impacts on avian species was established in 1991 by a study conducted for the San Diego Association of Governments in which “it was theoretically estimated that noise levels in excess of 60 dB(A) Leq in [Least Bell’s] vireo habitat would mask the bird’s song, subsequently reducing the reproductive success of this species during their breeding season....” (County of San Diego 2000). This study, on which the U.S. Fish and Wildlife Service apparently based its acceptance of the 60 dB(A) threshold as well, to our knowledge has never been published or peer reviewed. The DEIR/EIS refers to Bowles and Wisdom (2005) as a source for the standard but this published abstract of a conference paper questions, and does not support, the use of the 60 dB(A) standard.

Since 1991, scientific understanding of the effects of noise on birds has improved greatly, with studies published that present heuristic and mathematical models that quantify the pattern of impacts caused by noise (Hill 1990; Reijnen and Foppen 1994; Reijnen et al. 1996; Reijnen et al. 1997; Forman et al. 2002; Peris and Pescador 2004; Slabbekoom and Ripmeester 2008). Rather than relying on undocumented research nearly two decades old, it is incumbent upon the applicant to incorporate the best and most up-to-date scientific evidence of the impacts of noise on breeding birds in the environmental analysis of the proposed project.

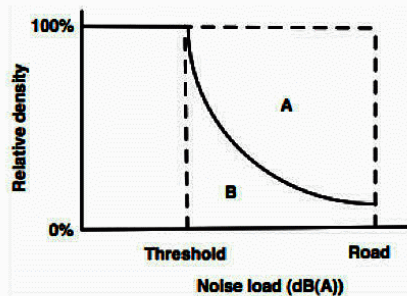


Figure 1. Threshold model for relative breeding density of birds plotted against traffic noise, where T is the threshold value and R the value at the roadside [or other noise source]. The decrease factor of the density = area of A/(area of A + B). Caption and figure reproduced from Reijnen et al. (1995).

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In the late 1990s, a group of Dutch ecologists investigated the effects of traffic noise on breeding bird density. Of 45 bird species investigated in woodlands in The Netherlands, 33 showed significantly depressed breeding density near roads. All species in the small passerine families Sylviidae, Fringillidae, and Emberizidae were affected by noise (Reijnen et al. 1997). This research also showed that noise effects followed a threshold model (Reijnen et al. 1995). This means that up to a certain noise level, no decrease in density is observed. When noise increases beyond that threshold level, bird density decreases dramatically in the area between the location at which that threshold is met and the road (Figure 1). The decreased density over the area with noise greater than the threshold level ranges from 30% to 100% and is known as the “decrease factor” (Reijnen and Foppen 1995; Reijnen et al. 1995). These two variables, the threshold and the decrease factor, describe the impact of road noise on breeding birds. Empirical measurement of the threshold value in woodlands shows that for all bird species combined the threshold value is 42–52 dB(A), with individual species exhibiting thresholds as low as 36 dB(A) and as high as 58 dB(A) (Reijnen and Foppen 1995; Reijnen et al. 1995). Furthermore, years with overall low population densities showed lower threshold levels. This information can be used to evaluate the impacts of noise from the proposed project from construction, maintenance, and operation (corona noise).

The least Bell’s vireo and southwestern willow flycatcher are small songbirds that rely on hearing songs to attract mates and defend territories. Habitat for both species would be impacted by noise from the proposed project (Figs. Ap8C-06, Ap8C-10). The studies of road noise from Europe include similar small songbirds that use acoustical communication. The threshold levels for two European warbler species (*Phylloscopus sibilatrix* and *Phylloscopus trochilus*) are 26 dB(A) and 39 dB(A), with decrease factors of 0.61 and 0.38, meaning breeding density was diminished to ~40–60% of undisturbed levels (Reijnen et al. 1995). From the published literature, therefore, a reasonable threshold based on similar species for least Bell’s vireo and southwestern willow flycatcher would be 40 dB(A) or below. Data from California support this conclusion. In 1999, Haas recorded sound levels (one hour A-weighted Leq) at 87 locations in the vicinity of the southwestern willow flycatcher colony along the San Luis Rey River in the vicinity of the Lake Henshaw Dam. The study site harbors the most robust and stable southwestern willow flycatcher colony in California. Sampling locations were established along the river; 100 meters

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(the approximate average length of a southwestern willow flycatcher territory within the colony) separated each location. The territories were nearly identical in all habitat characteristics except sound level. Of these territories, 44 were occupied by either a pair of flycatchers ($n = 42$) with a nest, a solitary male ($n = 1$), or a solitary female ($n = 1$). Using sound as the independent variable, and occupancy as the response variable, I completed a logistic regression on these data. The results were highly significant ($p < 0.0001$, $r^2 = 0.49$), indicating with certainty that territory occupancy is reduced by sound levels in the 50–60 dB(A) range.

A conclusion that noise impacts on sensitive bird species such as southwestern willow flycatcher and least Bell's vireo start below 50 dB(A) is robust. Thresholds for other bird species have been determined to be in the 40–50 dB(A) range (Reijnen et al. 1997). The 60 dB(A) threshold currently used by the DEIR/EIS will be ineffective at eliminating noise impacts, and in fact noise at the 50–60 dB(A) level could deter breeding activity altogether for some species. According to the DEIR/EIS, corona noise from the 500 kV transmission line would increase ambient noise levels within the project right of way to 52 dB(A) along a number of project links under certain weather conditions (Table D.8-13). Noise from construction and maintenance activities would also increase noise levels for sensitive bird species. These impacts should be evaluated with a lower threshold that is based on the published scientific literature rather than the unsubstantiated 60 dB(A) threshold.

Helicopter Disturbance

The DEIR/EIS discloses that 111 towers will be built using helicopters to deliver materials (p. B-84) and furthermore describes complete inspection of the system using helicopters on at least an annual basis (p. D.2-149). Yet the DEIR/EIS only describes helicopter disturbance within the context of impacts to Peninsula bighorn sheep (p. D.2-114). The DEIR/EIS gives no limits to the frequency of helicopter flyovers for the lines (p. D.8-18). Many other wildlife groups are affected by helicopter disturbance than bighorn sheep (Efroymson and Suter 2001), and the DEIR/EIS does not contain a complete discussion of the impacts of helicopter disturbance on these groups. Efroymson and Suter (2001) summarized the literature on the effects of military overflights on wildlife and found thresholds for impacts to wildlife from rotary-wing aircraft for raptors, waterfowl, and ungulates. For example, flights within 15 km can disturb waterfowl,

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which only sometimes become habituated to such disturbance (Efroymsen and Suter 2001). Raptors can similarly be disturbed and while some species can become habituated (such as red-tailed hawks, which are known for habituating to human activity) other species may abandon an area that has been disturbed by helicopter overflights (Andersen et al. 1989). The DEIR/EIS uses a mitigation approach for golden eagles that limits disturbance from helicopters (and other noise sources) to the period outside of breeding season when within 4,000 feet of a nest site (Mitigation Measure B-7h). This measure is not sufficient to protect golden eagles from adverse impacts. Scientific literature on this subject is clear, “The presence of humans detected by a raptor in its nesting or hunting habitat can be a significant habitat-altering disturbance even if the human is far from an active nest” (Richardson and Miller 1997). Regardless of distance, a straightline view of disturbance affects raptors, and an effective approach to mitigate impacts of disturbance for golden eagles involved calculation of viewsheds using a three-dimensional GIS tool and development of buffers based on this (Camp et al. 1997; Richardson and Miller 1997). The DEIR/EIS assumes that impacts to golden eagles can be avoided by a 4,000-foot buffer from nest sites, but this approach will not avoid disturbance to hunting habitat or line-of-sight impacts from nest sites, regardless of distance. Helicopters will be a chronic intrusion into areas that currently have no such artificial disturbance.

Electromagnetic Fields

The DEIR/EIS contains an electromagnetic field (EMF) management plan, but places undeveloped land as the lowest priority for implementation of low-cost measures to reduce EMFs (Appendix 7, p. 6). This approach ignores the adverse impacts of EMFs on wildlife that have been documented in the scientific literature.

Birds are closely associated with powerlines through perching, nesting on supporting structures, and exposure to EMFs in habitats below and adjacent to lines (Femie and Reynolds 2005). An experimental study exposed America kestrel (a raptor found along the project route) to electromagnetic fields equivalent to being under a 735 kV transmission line (Femie et al. 2000). The pairs exposed to EMFs had higher fertility but poorer hatching success (Femie et al. 2000). Behavior was affected as well, with pairs exposed to EMFs maintaining higher activity levels.

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Such activity is not desirable during nesting when reductions in activity levels are associated with egg-laying and protection of eggs (Ferne and Reynolds 2005).

A German study showed increased egg size in one species nesting under a 100 kV power line, decreased egg size in another species, and no difference in two other species (reported in Ferne and Reynolds 2005). A review of studies of embryonic development found that most studies (88%) found adverse effects resulting from exposure to EMFs similar to that experienced by nesting under power lines (Ferne and Reynolds 2005). Exposure to EMFs also has been shown to inhibit production of the hormone melatonin, which helps to regulate seasonal behaviors such as nesting, molt, and migration (Ferne et al. 1999). Even though relatively few studies of the effects of EMFs on birds have been completed, “much of the research has found that EMF exposure has generally affected birds, and most of the effects have been adverse” (Ferne and Reynolds 2005). The DEIR/EIS errs in failing to consider the impacts of EMFs on birds and other wildlife and consequently fails to identify significant adverse impacts to bird habitat across the aboveground portions of the proposed transmission line.

Fragmentation Impacts

The proposed project will have impacts to native ecosystems that extend well beyond the footprint of the transmission towers and associated road infrastructure. These impacts are not adequately described in the DEIR/EIS. One such mechanism is through “bottom-up” effects whereby invertebrate communities are disrupted, which then affects other wildlife. Disturbance of natural scrub and chaparral communities will promote the invasion of alien insect species, such as the Argentine ant (*Linepithema humile*). The deleterious effect of Argentine ants on native arthropods is well documented; many studies report a decrease in arthropod diversity as Argentine ant abundance increases (Erickson 1971; Cole 1983; Human and Gordon 1996, 1997; Holway 1998a; Kennedy 1998). The proposed project will promote invasion of Argentine ants by providing two conditions that increase invasion: a water source (Holway 1998b; Human et al. 1998; Holway and Suarez 2006) and increased disturbance (Human et al. 1998). These are provided in the form of watering for dust suppression (D.2-165), washing of insulators on towers (B-98), and by construction and maintenance activities. Argentine ants invade far beyond dis-

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turbed areas and water sources and into surrounding undisturbed habitats, with increased abundance documented to a distance of up to 650 feet (Suarez et al. 1998).

The proposed project will also involve destruction of habitat as part of the fuels management program (p. D.15-64). Community level analysis indicates that arthropod species composition will change and overall diversity will decrease when native habitats are subjected to fuel modification. Disturbed coastal sage scrub sites have fewer arthropod predator species such as scorpions and trap-door spiders, and are dominated by exotic arthropods such as Argentine ants, European earwigs (*Forficula auricularia*), pillbugs and sowbugs (*Armadillidium vulgare* and *Porcellio* sp.), and the sowbug killer (*Dysdera crocata*) (Longcore 2003). These changes in arthropod species diversity will have resonating impacts on vertebrates that use arthropods as prey species. Suarez et al. show that coast horned lizards prefer native ants (*Pogonomyrmex* and *Messor* spp.) as their food source and suffer when these species are eliminated by invading Argentine ants (Suarez et al. 1998).

Disturbance associated with road building and vegetation clearance promotes the invasion of plant species already associated with residential development. Alien plant species found in southern California wildlands are largely associated with disturbed areas, including cleared areas (Rundel 2000). This relationship between invasive exotics and disturbance is found throughout California and in other Mediterranean regions (Kotanen 1997; Rundel 1998). The understories of areas subject to fuel modification are rapidly dominated by invasive exotic grasses and forbs. As described by Keeley, "Prefire fuel manipulations such as fuel breaks produce conditions that favor weedy aliens and thus act to increase the alien presence, increase the movement of aliens into wildlands, and increase seed sources capable of invading after fire" (Keeley 2002). Incidentally, this increases fire frequency as well (Minnich and Dezzani 1998).

As discussed extensively in the literature (Mooney et al. 1986; Minnich and Dezzani 1998; Rundel 1998), invasive plant species can profoundly affect ecosystem structure and function by modifying fire regimes, nutrient cycling, and erosion patterns. The roads, towers, and associated fuel modification will affect an area far greater than the footprint of these activities themselves by promoting the invasion of exotic plants and animals into wildlands.

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Inadequacy of Analytical Approach

The presentation of significant impacts categorized by impact class and associated mitigation measures without the necessary studies is a hallmark of the DEIR/EIS. In numerous instances the DEIR/EIS makes conclusions about the severity of impacts based on incomplete information and defers the surveys necessary to gather this information until after project approval. An environmental disclosure document fails if it simply acknowledges vague significant impacts but does not actually provide information about the scope and nature of those impacts. This information is critical because it is needed for the public and decisionmakers to determine if mitigation measures can offset the impacts, whether impacts can be avoided, and whether it is tolerable to approve the project even though the significant impacts remain. The non-specific approach characterized by the entire DEIR/EIS denies the public and decisionmakers knowledge of the actual extent of the impacts on biological resources. For example, the DEIR/EIS acknowledges that the development of a project in Mexico near La Rumorosa would create a significant impact from the collision of birds with turbines (p. D.2-263) but provides no further detail on the scope of this impact or the species that are likely to be involved, save for a general species list (p. D.2-248). It might have been possible, based on site surveys and comparison with other wind projects, to predict that the project would kill around 815 birds per year (using the equation in the caption of Figure 1 of Barclay et al. 2007 as a rough approximation, assuming 125 440-foot tall turbines). This number could include golden eagles and other sensitive species. Collision mortality would be a significant impact that cannot be mitigated, which is the same conclusion reached in the DEIR/EIS, but such descriptions of magnitude would allow decisionmakers to weigh whether the overall benefit of the proposed project would be greater than the significant impacts it would have.

Another example illustrates the need for more specificity in the impact analysis. The DEIR/EIS provides no estimate of the number of birds that might collide with the transmission wires or what species they might be. Absent the field surveys necessary to describe such risks, the scientific literature provides some guidance. Janss and Ferrer (1998) found 43 birds in 20 surveys conducted over two years with some spans marked with diverters during the second year on 4.5 km of 380 kV line on lattice towers through scrubland, grassland, and agricultural lands in Spain, equaling 1.7 birds per mile per year. Approximately 30% of these birds were common cranes

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(Grus grus), closely related to sandhill cranes (*Grus canadensis*). If one assumes that the first 40 miles of the proposed project are located adjacent to agricultural lands used for foraging by sandhill cranes, extrapolation of the Spanish study would suggest mortality of 68 birds per year on this portion of the project, of which 20 would be sandhill cranes, a threatened species that is fully protected under California law. Because only 320 sandhill cranes have been recorded wintering at the Salton Sea (Shuford et al. 2002), they may constitute a smaller proportion of deaths than common cranes did in the Spanish study, but even killing ten or five cranes per year would constitute a significant impact. Such extrapolations are limited by their underlying assumptions but provide the resource agencies, the public, and decisionmakers with information to assess the extent of the “significant” impacts identified by the DEIR/EIS. This type of information is also necessary to assess whether the mitigations proposed in the DEIR/EIS will actually offset impacts as asserted for those impacts determined to be “Class II.”

Deferred Mitigation and Restoration

The mitigation measures for loss of bird habitat (i.e., sensitive vegetation) include the development of a Habitat Restoration Plan that is approved by the resource agencies (MM B-1a). Despite the detail provided in this mitigation measure about how the restoration plans will be formulated, there is ultimately not enough information to assess whether such restoration projects would offset the impacts identified in the DEIR/EIS. Furthermore, by deferring the preparation of restoration plans until a later date, the public is denied the opportunity to review and comment on such plans, even though they will determine the efficacy of the mitigation proposed in the DEIR/EIS.

Restoration is the central tool proposed to offset impacts to sensitive vegetation types. For many vegetation types a 1:1 mitigation ratio is proposed. Given what is known about the failure rate of restoration projects in southern California, it is inappropriate to rely on restoration to offset impacts of the proposed project, especially when proposed at a 1:1 ratio.

The DEIR/EIS, through its mitigation measures, essentially asserts that restored habitats, such as coastal sage scrub, are equal in value to natural habitats. This assumption is not supported by the scientific literature (Longcore 2003). Ecological restoration is difficult at best and many projects

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fail for many reasons in recreating whole communities (not just habitat for single target species) (Longcore et al. 2000). Research from coastal sage scrub showed that in the case of three restoration projects, native arthropod diversity was significantly lower at restoration sites (even up to ten years old) than at comparable reference sites (Longcore 2003). Arthropods are important to mitigation because they are excellent indicators of habitat quality, they constitute a significant proportion of site biodiversity, and they play a range of ecological roles as prey, predators, decomposers, and herbivores (Kremen 1992; McGeoch 1998; Bolger et al. 2000; Longcore 2003). Another study using arthropods to evaluate restored riparian woodland in California found significantly lower numbers of predaceous and parasitic arthropods at restored sites (Williams 1993, 1997). While revegetation projects can be implemented that are successful in providing habitat for some bird species (Farley et al. 1994; Kus 1998), the overall biodiversity of the created habitat is generally far lower than native habitats and does not serve to mitigate the loss of sensitive vegetation. It is therefore appropriate to mitigate direct habitat losses at greater than a 1:1 ratio because the quality of the resulting “restored” habitat is invariably lower than native scrub habitat.

Restoration is also a suboptimal method to mitigate for wetland losses. For example, in an analysis of the hydrology, biogeochemistry, and biology of 256 acres of riparian mitigation in Orange County, it was found that none of the sites met minimal levels of wetland functions (Sudol and Ambrose 2002). A separate review of wetland mitigation projects in California found that even though permittees generally followed their permit conditions, the resulting wetlands are not similar to natural wetlands (Ambrose et al. 2006). This means that from the standpoint of environmental assessment it is inappropriate to rely on the mitigation plans approved by the resource agencies to ensure that restoration projects provide similar functions, values, and species diversity as the natural habitats they replace.

Desert ecosystems are especially hard to restore because of the low rate of vegetative growth. Desert soils are often dominated by cryptobiotic crusts that are made of mosses, cyanobacteria, fungi, blue-green algae, and bacteria (Belnap 1993; St. Clair and Johansen 1993). Once disturbed, these crusts are exceedingly difficult to restore (Bowker 2007). Natural rates of regeneration are slow and even with restoration efforts recovery of disturbed sites may take decades to hundreds of years (Belnap 1993; Bowker 2007). These crusts are important because they pro-

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vide nutrients to plants (Harper and Pendleton 1993) and reduce soil erosion (Belnap and Gardner 1993), and they may inhibit the spread of invasive exotic plant species (Mattoni et al. 1997). Because of the slow growth of plants and the difficulty of restoring soil crust communities, scientists consider that for desert ecosystem restoration, “the probability for long-term success is low to moderate” (Lovich and Bainbridge 1999).

One of the reasons the restoration plans for the proposed compensatory mitigation cannot be deferred until after project approval is that resource agencies frequently approve performance criteria that result in the use of only a handful of common species in a restoration. In restoration plans I have reviewed, despite having been approved by resource agencies, the planting palette included less than half of the native plant diversity that would have been present historically at a site. For coastal sage scrub habitats, restorations often omit annual wildflowers, bulbs and other monocots, mosses, cryptobiotic crusts, and ferns. This type of “restoration” will not replicate the functions and values of native coastal sage scrub. For example, no “fire following” annual wildflowers will be in the seed bank when restored sites eventually burn. In addition, because of the lack of native annual species, the restorations will be susceptible to invasion by exotic annual grasses following any disturbance. The restoration plans, including locations, current conditions, plant lists, performance criteria, monitoring plans, and criteria for remedial action if performance criteria are not met must be disclosed in the DEIR/EIS to allow for public comment and technical review.

Route Options

The DEIR/EIS evaluates the relative environmental impacts of different alternative routes for the transmission lines as well as other actions to achieve the project objectives. The proposed power line routes, in all of the alternative forms presented, will have significant adverse impacts to birds and other wildlife. I reviewed the various transmission line alternatives (northern and southern routes) and considered the biological information presented in the DEIR/EIS along with detailed aerial photographs of the project routes. The preferable outcome from a biological perspective is that neither route be constructed. Within that context, I offer the following comments.

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The FTHL Eastern Alternative traverses less native desert habitat by cutting through agricultural areas but would pose an increased risk of collision with birds that forage in the agricultural fields, especially sensitive species such as white-faced ibis and greater sandhill crane, and this impact is not considered in the alternatives analysis.

The West of Dunaway Alternative is inferior to the proposed project and the FTHL Eastern Alternative because it is longer and involves more habitat disturbance, including the staging area.

The West Main Canal Alternative is similar to the FTHL Eastern Alternative in that it avoids desert habitat impacts but increases avian collision risk.

The proposed project segment to the southwest of the Salton Sea that runs northwest then turns west at State Route 78 is particularly problematic because it separates the Salton Sea and its adjacent wetlands from the wetlands of the San Sebastian Marsh and San Felipe Creek. Surveys of bird use and movement between these areas should be undertaken to identify the collision risk posed by this placement.

From a fragmentation perspective, the line route should not cut south and follow Old Kane Springs Road but should follow Route 78. This portion of the Imperial Valley link is 500 kV with a 93 kV underbuild. The stacked design with 93 kV lines at a lower level, 500 kV lines at another level, and ground lines above them presents a broad vertical target for avian collisions in a region where migratory birds may encounter them. Radar studies and visual observations are especially needed in this region.

The Partial Underground ABDSP SR78 to S2 Alternative, Underground Portion is superior to the proposed project because it follows the existing road, and avoids extensive roadbuilding and habitat impacts. The underground option is also superior because it avoids construction of the Top of the World Substation. Both of the alternative sites for this substation would have substantial adverse effects and require additional grading compared with the east of ABDSP substation that would be constructed for the underground option.

The proposed project near the Top of the World Substation involves massive roadbuilding to access the lines and extends through otherwise undisturbed chaparral vegetation.

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Of the several routes running south down Route 79 from the Lake Henshaw area, the Santa Ysabel SR79 Underground option is superior because it avoids the fragmentation and habitat loss associated with the aboveground route and its access roads.

Farther along in the Coastal Link, the Los Peñasquitos Canyon Preserve and Mercy Road Alternative is an underground route that is worse than the proposed project because it disturbs existing preserve areas. This raises an additional question for the evaluation of project impacts. The DEIR/EIS reports on the compliance of various routes with federal, state, and local land use plans. It is not evident, however, whether the project would involve construction and impacts in areas that were set aside as mitigation in previous CEQA or NEPA documents. Many of the developments in San Diego County were approved based on assumptions about the protection of habitats set aside within and adjacent to the developments in addition to off-site mitigation sites.

The southern transmission route is superior to the northern route because it follows an existing transmission line through much of the inland reaches, then follows Interstate 8 through the mountains. By staying close to existing development and disturbance sources this route is somewhat less damaging than the northern route. The DEIR/EIS, however, identifies Modified Route D as part of its “environmentally superior” southern route. From a biological perspective, Route D is worse than the Interstate 8 alignment because it is longer, destroys more native vegetation, and would disturb an additional golden eagle nest site and additional least Bell’s vireo habitat. The only reason the DEIR/EIS identifies Modified Route D as superior is because of reduced visual impacts, but this choice comes at the expense of biological resources.

Wind Development

The DEIR/EIS contains a description of impacts and mitigation measures for the development of a wind power generation project to be located at an undetermined site in northern Mexico near La Rumorosa. The DEIR/EIS does not describe the exact route for the transmission line either in Mexico or the United States or the location of the wind turbines. This portion of the DEIR/EIS fails to meet common standards for provision of a complete and consistent project description. It furthermore fails to show adherence to the State of California’s guidelines for design and siting of wind facilities to reduce impacts to birds and bats (California Energy Commission 2007).

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These guidelines identify the need to collect one or more years of field data on bird and bat populations for projects located in areas that may impact special status species (California Energy Commission 2007, p. 9). The DEIR/EIS simply cannot support any conclusions about the proposed project element without conducting the necessary field studies.

The description of the impacts of wind development contains the assertion that taller towers would decrease raptor mortality at the La Rumorosa site (D.2-262). However, recent research has shown that turbine height is weakly and positively correlated with bird mortality, and taller turbines kill exponentially more bats than shorter turbines (Barclay et al. 2007). Bat mortality at wind projects is a grave conservation concern (Kunz et al. 2007; Arnett et al. 2008) and recent research should be incorporated into the DEIR/EIS to identify and avoid these impacts.

Conclusion

The absence of detail about the magnitude and species-specific context of impacts is a pervasive problem with the DEIR/EIS. The logical and factual basis upon which evaluation of mitigation and minimization measures rests is absent in many instances. Useful comparative information from other similar projects that might help quantify impacts is missing. In sum, the DEIR/EIS is insufficient because it fails to identify significant impacts that will result from the project, it fails to provide adequate descriptions of the identified significant impacts and their mitigation measures, and it lacks the analytical connective reasoning to place impacts to biological resources in context.

I declare under penalty of perjury this testimony is, to the best of my knowledge, true and correct.

/s/ Dr. Travis Longcore

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List of Attachments

Attachment A: Curriculum Vitae of Dr. Travis Longcore

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Attachment A

TRAVIS LONGCORE

P.O. Box 24020
Los Angeles, California 90024-0020
Telephone: (310) 247-9719

CURRENT APPOINTMENTS

- University of Southern California 2001–present
Research Assistant Professor, Department of Geography
Director of Urban Ecological Research, Center for Sustainable Cities
Faculty Affiliate, GIS Research Laboratory
Instructor, Master of Liberal Studies Program (2007–present)
- The Urban Wildlands Group, Co-founder and Science Director 1996–present
The Urban Wildlands Group is a 501(c)(3) nonprofit organization dedicated to the conservation of species, habitats, and ecological processes in urban and urbanizing areas. We conduct and publish applied research that aids formulation and implementation of policies to protect urban biodiversity and conduct targeted advocacy actions on issues that can set conservation precedents.
- Land Protection Partners, Principal 1998–present
Consultant in environmental policy and land protection actions. Services include issue identification, preparation of biological analysis with supporting scientific literature review, and communication with resource agency personnel.

EDUCATION

- Ph.D., Geography, University of California, Los Angeles 1999
Dissertation Title: *Terrestrial Arthropods as Indicators of Restoration Success in Coastal Sage Scrub*. Allied field: Organismic Biology, Ecology, and Evolution
- M.A., Geography, University of California, Los Angeles 1995
Thesis Title: *Risk, Technology, and Place: Siting a Radioactive Waste Dump in California's Ward Valley*
- Honors B.A., Geography *summa cum laude*, University of Delaware 1993
Thesis Title: *Information Technology and World City Restructuring: The Case of New York City's Financial District*. Minor: French

PROFESSIONAL EXPERIENCE

- University of California, Los Angeles 2000–2007
Lecturer, Department of Geography
Lower Division: Biodiversity in a Changing World, People and the Earth's Ecosystems
Upper Division: World Vegetation, Forest Ecosystems, Environmental Impact Analysis, Biore-source Management
Lecturer, Department of Ecology and Evolutionary Biology
Upper Division: Introduction to Ecology and Behavior (co-taught), Ecology, Field Ecology
Lecturer, Institute of the Environment
Lower Division: Ecology and Conservation of California Oaks, Nature After Dark

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Postdoctoral Research Associate, Sustainable Cities Program, University of Southern California	1999–2001
Summer Instructor, UCLA Graduate School of Education and Information Studies	1997–1999
Staff Researcher, UCLA Department of Geography	1996–1999
Teaching Assistant, UCLA Department of Geography	1995–1996
Geographic Information System Technician, Water Resources Agency, New Castle County, Delaware	1992–1993

HONORS AND AWARDS

Conference Travel Grant, UCLA Department of Geography	1999
Dissertation Improvement Grant, National Science Foundation (\$8,000)	1998
Distinguished Doctoral Scholar Fellowship, UCLA Alumni Association (\$17,500)	1998
Portable Fellowship, UCLA Graduate Division (\$18,500)	1997
Graduate Research Fellowship, National Science Foundation (\$64,400)	1993
Chancellor’s Fellowship, UCLA Graduate Division (declined)	1993
Alexander J. Taylor Award (“Outstanding Senior Man”), University of Delaware	1993
Geography Faculty Award, University of Delaware	1993
Phi Kappa Phi Graduate Fellowship, Chapter Award, University of Delaware	1993
Mid-Atlantic Region Finalist, Rhodes Scholarship	1992
Fellow, Arizona Honors Academy, Northern Arizona University	1992
Marie Donaghay Award for Excellence in Geography, University of Delaware	1992
Phi Beta Kappa	1992
Pi Delta Phi (French national honor society)	1992
Phi Kappa Phi (national honor society)	1991
Phi Beta Kappa Clift and DeArmond Award, for sophomore with “greatest intellectual promise,” University of Delaware	1991
George and Margaret Collins Seitz Award, for sophomore showing “extraordinary traits of fine character,” University of Delaware	1991
Eugene duPont Memorial Distinguished Scholar Award, University of Delaware (\$44,500)	1989

PUBLICATIONS

Book

- Rich, C., and T. Longcore (eds.). *Ecological consequences of artificial night lighting*. Island Press, Washington, D.C. (2006).

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- Longcore, T. Ecological effects of fuel management practices around residential development [sidebar]. Pages 527–528 in N. G. Sugihara, J. W. van Wagtenonk, K. E. Shaffer, J. Fites-Kaufman, and A. E. Thode (eds.), *Fire in California’s ecosystems*. University of California Press, Berkeley (2006).

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1. Rich, C., and T. Longcore. Introduction. Pages 1–13 in C. Rich and T. Longcore (eds.). *Ecological consequences of artificial night lighting*. Island Press, Washington, D.C. (2006).

Refereed Articles

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17. Elvidge, C. D., P. Cinzano, J. Arvesen, P. Sutton, C. Small, R. Nemani, T. Longcore, C. Rich, J. Weeks, and S. Ebener. The Nightsat mission concept. *International Journal of Remote Sensing* 28(12):2645–2670 (2007).
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13. Longcore, T., C. Li, and J. P. Wilson. Applicability of CITYgreen urban ecosystem analysis software to a dense urban neighborhood. *Urban Geography* 25(2):173–186 (2004).
12. Longcore, T., and C. Rich. Ecological light pollution. *Frontiers in Ecology and the Environment* 2(4):191–198 (2004).
11. Longcore, T. Arthropods as indicators of restoration success in coastal sage scrub (California, U.S.A.). *Restoration Ecology* 11(4):397–409 (2003).
10. Mattoni, R., T. Longcore, Z. Krenova, and A. Lipman. Mass rearing the endangered Palos Verdes blue butterfly (*Glaucopsyche lygdamus palosverdesensis*: Lycaenidae). *Journal of Research on the Lepidoptera* 37:55–67 (2003).
9. Longcore, T., R. Mattoni, C. Zonneveld, and J. Bruggeman. [INCA] INsect Count Analyzer: a tool to assess responses of butterflies to habitat restoration. *Ecological Restoration* 21(1):60–61 (2003).
8. Longcore, T. Ecological effects of fuel modification on arthropods and other wildlife in an urbanizing wildland. Pp. 111–117 in K. E. M. Galley, R. C. Klinger, and N. G. Sugihara (eds.). *National Congress on Fire Ecology, Prevention, and Management Proceedings*, No. 1, Tall Timbers Research Station, Tallahassee, Florida (2003).
7. Zonneveld, C., T. Longcore, and C. Mulder. Optimal schemes to detect presence of insect species. *Conservation Biology* 14(2):476–487 (2003).
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4. Mattoni, R., T. Longcore, and V. Novotny. Arthropod monitoring for fine scale habitat analysis: a case study of the El Segundo sand dunes. *Environmental Management* 25(4):445–452 (2000).
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2. Longcore, T. Review of *From Coastal Wilderness to Fruited Plain: A History of Environmental Change in Temperate North America from 1500 to Present*, by G. G. Whitney. *Ethics, Place and Environment* 4(3):278–279 (2001).
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69. Johnson, J.J., T. Longcore, A. Clause, G. Pratt, J. Dunn, and K. Osborne. 2007. Propagation handbook for Lange's metalmark butterfly, *Apodema mormo langei*. First edition, August 2007. The Urban Wildlands Group, Los Angeles.
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67. Longcore, T. Final report for 2006 Palos Verdes blue butterfly adult surveys on Defense Fuel Support Point, San Pedro, California. The Urban Wildlands Group, Los Angeles, 13 pp. (Defense Logistics Agency Agreement # N68711-06-LT-R0011) (May 16, 2007).
66. Longcore, T., and C. Rich. Comments on biological resources analysis in Final Environmental Impact Report: Diamond Rock Sand and Gravel Mine and Processing Facility. Land Protection Partners, Los Angeles, 7 pp. (May 30, 2007).
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63. Longcore, T., and C. Rich. Ecological impacts of artificial night lighting from proposed Cabrillo Port Liquefied Natural Gas Deepwater Port. Land Protection Partners, Los Angeles, 10 pp. (April 4, 2007).
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61. Johnson, J., T. Longcore, and R. Mattoni. Final Report for Palos Verdes Blue Butterfly Year 2006 Captive Rearing on Defense Fuel Support Point, San Pedro, California. The Urban Wildlands Group, Los Angeles, 21 pp. (Defense Logistics Agency Agreement # N62473-06-LT-R0011) (January 11, 2007).
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57. Longcore, T. The Green Visions Plan for 21st Century Southern California: A Guide for Habitat Conservation, Watershed Health, and Recreational Open Space. 8. Conservation of Native Biodiversity in the City: An Assessment of MRCA Projects in the Upper Los Angeles River Watershed, University of Southern California Center for Sustainable Cities, Los Angeles, California, 29 pp. (April 2006).
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51. Longcore, T., and R. Mattoni. Final report for 2005 Palos Verdes blue butterfly adult surveys on Defense Fuel Support Point, San Pedro, California. Los Angeles, The Urban Wildlands Group (Defense Logistics Agency Agreement # N68711-05-LT-A0012), 11 pp. (July 1, 2005).
50. Longcore, T. (ed.), Beach Bluffs Restoration Project Master Plan. Redondo Beach, California, Beach Bluffs Restoration Project Steering Committee, 66 pp. (April 2005).
49. Deviny, J., T. Longcore, and A. Bina with C. Kitts and K. H. Osborne. Phytoremediation with native plants. Report to the Zumberge Fund for Innovation. Los Angeles, University of Southern California Center for Sustainable Cities, 66 pp. (March 15, 2005).
48. Longcore, T., and C. Rich. Reply to comments filed with Federal Communications Commission on WT Docket No. 03-187, Avatar Environmental, LLC, report regarding migratory bird collisions with communications towers. Los Angeles, Land Protection Partners, 15, pp. (March 9, 2005).
47. Longcore, T., C. Rich, and S. A. Gauthreaux, Jr. Scientific basis to establish policy regulating communications towers to protect migratory birds: response to Avatar Environmental, LLC, report regarding migratory bird collisions with communications towers, WT Docket No. 03-187, Federal Communications Commission Notice of Inquiry. Los Angeles, Land Protection Partners, 33 pp. (February 14, 2005).
46. Mattoni, R., J. Sprute, and T. Longcore. Final report for Palos Verdes blue butterfly year 2004 captive rearing on Defense Fuel Support Point, San Pedro, California. Los Angeles, The Urban Wildlands Group (Defense Logistics Agency Agreement # N68711-04-LT-A0017), 7 pp. (December 27, 2004).

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45. Longcore, T. 2004. Strategic plan for captive rearing and reintroduction of Palos Verdes blue butterfly. Los Angeles: The Urban Wildlands Group (Defense Logistics Agency Agreement # N68711-03-LT-C3003). 11 pp. (November 1, 2004).
44. Longcore, T., R. Mattoni, and S. Casia. Report on southern dune and bluff scrub revegetation at Torrance Beach. Los Angeles, The Urban Wildlands Group, 10 pp. (September 23, 2004).
43. Longcore, T., and C. Rich. Letter Report to California Department of Fish and Game re Draft Environmental Document Sections 265, 460–467, and 472–480, Title 14, California Code of Regulations Regarding Furbearing and Nongame Mammal Hunting and Trapping. Los Angeles, The Urban Wildlands Group, 22 pp. (August 5, 2004).
42. Li, C., H. Chen, C. S. Lam, T. Longcore, J. Sayre, K. Schmoker, and J. R. Wolch. Green Visions Plan for 21st Century Southern California: A Guide for Habitat Conservation, Watershed Health, and Recreational Open Space. 2. Online Plan Library: Architecture and Analysis. University of Southern California GIS Research Laboratory and Center for Sustainable Cities, Los Angeles, California (July 2004).
41. Wolch, J. R., J. Deviny, T. Longcore, and J. P. Wilson. The Green Visions Plan for 21st Century Southern California: A Guide for Habitat Conservation, Watershed Health, and Recreational Open Space. 1. Analytic Framework. University of Southern California GIS Research Laboratory and Center for Sustainable Cities, Los Angeles, California (July 2004).
40. Longcore, T. Analysis of butterfly survey data and methodology from San Bruno Mountain Habitat Conservation Plan (1982–2000). 2. Survey Methodology. Los Angeles, USC GIS Research Laboratory and USC Center for Sustainable Cities, 6 pp. (April 2004).
39. Longcore, T., C. Lam, J. P. Wilson. Analysis of butterfly survey data and methodology from San Bruno Mountain Habitat Conservation Plan (1982–2000). 1. Status and Trends. Los Angeles, USC GIS Research Laboratory and USC Center for Sustainable Cities, 15 pp. (April 2004).
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37. Scow, J. C., C. Cohen, T. Longcore, and C. Rich. UCLA's campus forest: a community resource. Los Angeles, The Urban Wildlands Group, 52 pp. (January 16, 2004).
36. Longcore, T., D. D. Murphy, D. Deutschman, R. Redak, and R. Fisher. A management and monitoring plan for Quino checkerspot butterfly (*Euphydryas editha quino*) and its habitats in San Diego County. Advisory Report to County of San Diego, 48 pp. (December 30, 2003).
35. Longcore, T., and C. Rich. Review of biological resources analysis in Supplement to Draft Environmental Impact Statement/Environmental Impact Report for LAX Master Plan. Los Angeles, Land Protection Partners, 15 pp. (October 20, 2003).
34. Mattoni, R., J. Sprute, and T. Longcore. Final Report for Palos Verdes blue butterfly year 2003 captive rearing on Defense Fuel Support Point, San Pedro, California. Los Angeles, The Urban Wildlands Group (Defense Logistics Agency Agreement # N68711-03-LT-C3003), 9 pp. (September 30, 2003).
33. Longcore, T., and C. Rich. Review of biological impact analysis in Initial Study and Mitigated Negative Declaration (PD-S-942/TT5411), City of Simi Valley. Los Angeles, Land Protection Partners, 15 pp. (July 24, 2003).
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29. Pincetl, S., J. R. Wolch, J. P. Wilson, and T. Longcore. Toward a sustainable Los Angeles: a “nature’s services” approach. Los Angeles, USC Center for Sustainable Cities, 47 pp. (report to John Randolph Haynes and Dora Haynes Foundation, February 2003).
28. Longcore, T., C. Rich, J. Marzluff, and B. Nightingale. Peer review of artificial light and noise impact analysis in *Sand Point Magnuson Park Drainage, Wetland/Habitat Complex and Sports Fields/Courts Project Final Environmental Impact Statement [Seattle, Washington]*. Los Angeles, Land Protection Partners, 15 pp. (January 16, 2003).
27. Longcore, T., and C. Rich. Review of biological resources analysis in Malibu Bay Company Development Agreement Draft Environmental Impact Report. Los Angeles, Land Protection Partners, 28 pp. (November 11, 2002).
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The Inland Empire: Toward a More Human Metropolis, Mission Inn, Riverside, California, January 24, 2008

City of Los Angeles Taskforce on Los Angeles River Revitalization Plan, January 2008

American Society of Landscape Architects, UCLA Student Chapter, "Urban Wildlands Designs: Integrating Ecology and Landscape Architecture," November 2007

USC Watershed Forum, "Water and Land: Shaping the Future of the Los Angeles River Watershed," September 2007

Los Angeles River Master Plan Advisory Committee, "Green Visions Plan for 21st Century Southern California," October 2007

Morongo Basin Lighting Conference, "Lights Out! For Nature (and People)," October 2007

Los Angeles and San Gabriel Rivers Watershed Council, October 2006

University of Southern California, Center for Sustainable Cities, "Meeting the Sustainability Challenge," Executive Education, November 2005

Communication Tower Working Group, Research Subcommittee, April 2005

University of California, Los Angeles, Department of Urban Planning and Institute of the Environment, "Sustainable Development for the 21st Century" Seminar Series, April 2005

California Studies Association Sixteenth Annual Conference, "Sheltering Biodiversity: Living With Other Species In and Around Los Angeles," April 2004

University of California, Los Angeles, Department of Geography, February 2004

City of Los Angeles Department of Parks and Recreation, May 2003

City of Los Angeles Department of Public Works, September 2002

South Coast Wildlands Project Missing Linkages Workshop, August 2002

University of Southern California, Department of Geography, February 2002

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Santa Monica Mountains Conservancy, September 2001
California Native Plant Society, South Coast Chapter, August 2001
CLE International Endangered Species Act and Habitat Conservation Planning Conference, "The Integration of Science and Law in Habitat Conservation Planning," June 2001
California State University, Northridge, Olivatt Library, April 2001
University of California Natural Resources Continuing Conference, Wrigley Institute for Environmental Studies, April 2001
Society for Ecological Restoration, California Chapter Annual Conference, October 2000
University of Stockholm, Department of Zoology, September 2000
University of Göteborg, Department of Applied Environmental Science, September 2000
Lorquin Entomological Society, Los Angeles, California, June 2000
University of California, Los Angeles, Department of Geography, May 2000
Southern California Institute of Architecture, June 1998
Los Angeles Unified School District Target Science, "Butterflies in the City" Workshop Series, South Central Los Angeles Leadership Team, October 1998

PROFESSIONAL SERVICE

Referee, *Environmental Management*, *Journal of Research on the Lepidoptera*, *Journal of Tropical Forest Science*, *Land Degradation and Development*, *Landscape and Urban Planning*, *Landscape Research*, *Restoration Ecology*, *Transactions in GIS*, *Biological Conservation*, *Journal of Insect Science*, *American Midland Naturalist*, *Herpetological Conservation*
Member, Science Review Team, Carrizo Plain National Monument, 2007
Proposal Reviewer, National Fish and Wildlife Foundation, 2004–2005
Proposal Reviewer, National Science Foundation
Ecological Biology Cluster, 2005
Ecology Program, 2004
Member, Scientific Review and Advisory Panel, Puente Hills Landfill Native Habitat Preservation Authority Resource Management Plan, 2005
Co-Chair, Beach Bluff's Restoration Project Steering Committee, 2003–2006
Independent Scientific Advisor (Quino Checkerspot Butterfly), County of San Diego, 2002–2004
Baldwin Hills Park Citizens Advisory Committee, 2002
Conference Co-Chair, The Urban Wildlands Group and UCLA Institute of the Environment, *Ecological Consequences of Artificial Night Lighting*, 2001–2002
Member, Advisory Council, Yosemite Restoration Trust, 1999–2002
Member, Recovery Team (Technical Subteam), Quino Checkerspot Butterfly, U.S. Fish and Wildlife Service, 1999–2001
Newsletter Layout, Endangered Habitats League, 1998–2002
Member, Conference Steering Committee, UCLA Institute of the Environment, *California's Biodiversity Crisis: The Loss of Nature in an Urbanizing World*, 1998

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Managing Editor, *Journal of Research on the Lepidoptera*, 1997–1999
Member, Recovery Team, El Segundo Blue Butterfly, U.S. Fish and Wildlife Service, 1997–1998
Member, Environmental Review Board, County of Los Angeles (appointed by Los Angeles County Board of Supervisors), 1997–present
Editor, *Western Tanager*, newsletter of the Los Angeles Audubon Society, 1997
Vice President, Los Angeles Audubon Society, 1995–1997
Coordinator, Los Angeles Audubon Society Birdathon, 1996 (recognized by National Audubon Society, “Most Money Raised by a Rookie,” September–October issue of *Audubon* magazine)
Graduate Student Association Representative, UCLA Academic Senate Council on Planning and Budget, 1996–1999
Member, Graduate Affairs Committee, UCLA Department of Geography, 1995–1997
Member, Instructional Technology Committee, UCLA Department of Geography, 1993–1995

PROFESSIONAL AFFILIATIONS

Association of American Geographers
California Botanical Society
Ecological Society of America
Society for Ecological Restoration
Southern California Botanists

MEDIA INTERVIEWS AND COVERAGE OF RESEARCH

Bowles, J. Small-scale efforts can make inland cities greener, group says. *The Press-Enterprise* (Riverside, California; January 24, 2008). Conference presentation featured in news account.
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Ortega, J. Los aliados del desastre. *La Opinion* (October 24, 2007). Quoted on causes of California wildfires.
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Schoch, D. Rare butterfly is winging back. *Los Angeles Times*, B1 (July 9, 2007). Quoted on expansion of El Segundo blue butterfly to restoration project I designed.

Agostoni, K. Rare butterfly makes a royal South Bay comeback. *Daily Breeze* (July 9, 2007). Quoted on expansion of El Segundo blue butterfly.

LoManaco, C. Dazzling border lights worrying astronomers. *Tucson Citizen* (July 2, 2007). Quoted on effects of border lights on wildlife.

Rogers, K. Surviving on a wing and a prayer. *Las Vegas Review-Journal* (June 18, 2007). Quoted in response to Fish and Wildlife Service decision on The Urban Wildlands Group petition to list Mount Charleston blue butterfly as endangered.

Dale, D. Eliminating ice plant. *Turf Magazine* (April 2007). Quoted and photographs used in article documenting ice plant removal by restoration project I designed.

Schoch, D. Rosier future for rare butterfly. *Los Angeles Times*, B1 (March 26, 2007). Quoted on the captive rearing project I direct for Palos Verdes blue butterfly.

Ricci, J. Park to open a panoramic window on L.A. *Los Angeles Times*, B2 (January 23, 2007). Quoted on physical and social geographic context of new park.

Roberson, M.-R. Night, interrupted. *Zoogoer*, pp. 14–21 (January 2007). Quoted in overview article on ecological light pollution.

Pre-2007: Associated Press, *Boston Globe*, *The Californian* (Salinas, California), *Christian Science Monitor*, *Daily Breeze* (Torrance, California), *Daily Bruin* (Westwood, California), *Financial Times*, *The Globe and Mail* (Toronto), *Las Vegas Sun*, *Los Angeles Daily News*, *Los Angeles Times*, *Metro Santa Cruz*, *Milwaukee Journal Sentinel*, *National Geographic Today* (online), *The Press-Enterprise* (Riverside, California), *Sacramento News and Review*, *San Jose Mercury News*, Scripps Howard News Service (Washington, DC), *USA Today*, *Ventura County Reporter*, *The Westsider* (Los Angeles), *California Wild*, *Conservation In Practice*, *Discover*, *Life*, *People*, *Reader's Digest* (Canada), *Science*, *Science News*, BBC World Service, CNN Radio Español, KPCC ("Talk of the City"), National Public Radio ("Talk of the Nation"), ABC News, KNBC TV ("Today in LA"), KCAL News, KCBS News, National Geographic Television ("America's Endangered Species: Don't Say Goodbye"), NBC Nightly News

PHOTOGRAPHY

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March 12, 2008

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STATE OF CALIFORNIA – THE RESOURCES AGENCY

ARNOLD SCHWARZENEGGER, Governor

CALIFORNIA ENERGY COMMISSION
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VIA ELECTRONIC MAIL

July 2, 2007

United States Department of Energy
Office of Electricity Delivery and Energy Reliability, OE-20
Attention: Docket No. 2007-OE-02
Forrestal Building, Room 6H-050
1000 Independence Avenue, S.W.
Washington, D.C. 20585

Re: COMMENTS ON U.S. DEPARTMENT OF ENERGY'S DRAFT NATIONAL INTEREST ELECTRIC TRANSMISSION CORRIDOR DESIGNATION - SOUTHWEST AREA NATIONAL CORRIDOR

The California Energy Commission (Energy Commission) submits the following comments concerning the United States Department of Energy's (DOE) May 7, 2007, notice of Draft National Interest Electric Transmission Corridor (NIETC) Designations. Specifically, our comments concern the Southwest Area National Corridor, Docket No. 2007-OE-02.

The Energy Commission appreciates DOE's sound rationale and supports the proposed Southwest Area National Corridor NIETC designation. The Energy Commission understands the critical nature of bringing needed transmission on line, particularly in southern California. In earlier comments, we raised concerns that DOE's focus on congestion, as originally proposed, was too restrictive to address California's energy policy priorities.¹ The Energy Commission is pleased to see that DOE has applied a broad approach in identifying national interest corridors that recognizes the need to alleviate congestion and to address constraints that pose obstacles to reasonably priced power, diversity of supply, and energy security regardless of whether these constraints currently produce congestion.

The Energy Commission supports DOE's conclusion that one of the consequences of congestion in southern California is prolonged and exacerbated dependence on natural gas. DOE rightly concludes that inadequate transmission capacity leaves consumers exposed to higher prices and higher price volatility associated with natural gas. DOE has also explicitly recognized California's strong commitment to renewable resources by

¹ The Energy Commission submitted comments in Response to U.S. Department of Energy's August 2006 National Electric Transmission Congestion Study on October 10, 2006. The Energy Commission also provided comments in Response to the February 2, 2006 Notice of Inquiry Regarding Considerations for Transmission Congestion Study and Designation of National Interest Electric Transmission Corridors on March 6, 2006.

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including not only source locations with substantial amounts of existing, under-used generation, but also locations with potential for substantial development of wind, geothermal, and solar generation. We agree with DOE that improved transmission access to areas with renewable-based generation potential would diversify supply.

The Energy Commission continues to strongly recommend that DOE, as part of its NIETC efforts, develop a process to identify and protect sensitive areas in California that are unsuitable for transmission corridors. We include as an enclosure to this letter a listing of such areas we identified in our March 6, 2006, comments. While we recognize the importance of transmission infrastructure to meet the growing demands of California, we also continue to emphasize California's unique environmental, cultural, and scenic attributes and the need to protect these unique attributes in skillful corridor designation and permitting. As we stated in our earlier comments, protecting certain "no-touch zones" is vital to preserve attributes highly valued by Californians. DOE has concluded that adjusting the boundaries of a National Corridor to avoid parks or other environmentally protected areas is not necessary. We believe this approach fails to recognize the significant potential to streamline the existing planning and permitting process for transmission facilities by proactively identifying those areas where significant environmental impacts and controversies could be avoided altogether.

As the Energy Commission has previously stated, California will not easily cede its sovereignty over land-use decisions relating to transmission development in California. The Energy Commission believes federal pre-emption of state siting authority should only occur as a last resort and never be used to circumvent state environmental standards or mitigation requirements. However, we also believe that in cases where the state has been unable to make progress in approving vital projects, federal backstop authority would be beneficial. Despite good faith efforts to streamline transmission planning and permitting in California, the lack of timely decisions on important transmission projects continues to deeply concern the Energy Commission

The unmistakable message that the Energy Commission derives from the NIETC designation is the need to advance earlier in time the land use decisions needed to locate transmission lines in California. Key legislation (Chapter 4.3 of Division 15 of the California Public Resources Code)² enacted in 2006 created a state transmission corridor designation process for non-federal lands to address land use and environmental issues well in advance of the need for transmission facilities. The Energy Commission is the lead agency responsible for preparing the necessary environmental documentation for transmission corridor designation that is subject to review under the California Environmental Quality Act. For future transmission projects the Energy Commission's new designation process creates an improved linkage between transmission planning and permitting in California. California's new corridor designation process also links with DOE's energy corridor designation for federal lands in California pursuant to Section 368 of the federal Energy

² www.leginfo.ca.gov/pub/05-06/bill/sen/sb_1051-1100/sb_1059_bill_20060929_chaptered.html

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Policy Act of 2005 (EPAAct-05). Specifically, it can connect federal energy corridors with state transmission corridors to coordinate timely permitting of high-voltage transmission projects by both federal and state agencies. Competing land uses are exerting tremendous pressure throughout California to set aside lands for transmission corridors before options disappear. California's new corridor designation process supports and facilitates the banking of land needed for transmission infrastructure, thus effectively preserving, for later use, transmission corridors consistent with long-term planning determinations. The Energy Commission is currently developing regulations to govern the transmission designation process and plans to begin accepting corridor applications by the end of this year.

The Energy Commission's *Strategic Transmission Investment Plan (Strategic Plan)* also facilitates acceleration of land use decisions for transmission lines by identifying needed transmission investments that inform the state's corridor designation process. The *Strategic Plan* identifies and recommends actions required to implement transmission investments needed to ensure reliability, relieve congestion, and meet future growth in load. In considering the need for transmission, the Energy Commission examines non-wires alternatives to generation, including energy efficiency, demand response, and renewable resources. The first *Strategic Plan* was completed in November, 2005, and the *2007 Strategic Plan* is scheduled for publication later this fall.

As you are aware, the Energy Commission is a cooperating agency for Section 368 of the EPAAct-05 corridor designation process. We have been coordinating an interagency team of federal and state agencies to review proposals to designate new and/or expand existing energy corridors and examine alternatives to these corridors on federal lands in California. We will continue to offer our assistance with regard to designation of Section 368 corridors, particularly with the preparation of a West-Wide Energy Corridor Programmatic Environmental Impact Statement (PEIS) to evaluate issues associated with the designation of energy corridors on federal lands in eleven Western states. We will also continue to provide input for the ongoing NIETC process.

If you have any questions concerning our comments please contact:

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Thank you for the opportunity to comment on this important proposal. We look forward to working with DOE and other federal agencies to develop transmission infrastructure consistent with the energy needs and policy objectives of California.

Sincerely,



JACKALYNE PFANNENSTIEL
Chairman

Enclosures

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ATTACHMENT

WILD PLACES AT RISK

Bureau of Land Management Wilderness

- Black Mountain Wilderness, BLM California Desert Conservation Area
- Carrizo Gorge Wilderness, BLM California Desert Conservation Area
- Chuckwalla Mountains Wilderness, BLM California Desert Conservation Area
- Coyote Mountains Wilderness, BLM California Desert Conservation Area
- Fish Creek Mountains Wilderness, BLM California Desert Conservation Area
- Kelso Dunes Wilderness, BLM California Desert Conservation Area
- Little Chuckwalla Mountains Wilderness, BLM California Desert Conservation Area
- Mecca Hills Wilderness, BLM California Desert Conservation Area
- Newberry Mountains Wilderness, BLM California Desert Conservation Area
- Nopa Range Wilderness, BLM California Desert Conservation Area
- Old Woman Mountains Wilderness, BLM California Desert Conservation Area
- Orocoxia Mountains Wilderness, BLM California Desert Conservation Area
- Palo Verde Wilderness, BLM California Desert Conservation Area
- Piute Mountains Wilderness, BLM California Desert Conservation Area
- Rodman Mountains Wilderness, BLM California Desert Conservation Area
- Rice Valley Wilderness, BLM California Desert Conservation Area
- Sawtooth Mountains Wilderness, BLM California Desert Conservation Area
- Stepladder Mountains Wilderness, BLM California Desert Conservation Area
- Turtle Mountains Wilderness, BLM California Desert Conservation Area

Bureau of Land Management Study Areas

- Cady Mountains Wilderness Study Area, BLM California Desert Conservation Area
- Death Valley #17 Wilderness Study Area, BLM California Desert Conservation Area
- Dry Valley Rim Wilderness Study Area, BLM Eagle Lake Field Office
- Skedaddle Wilderness Study Area, BLM Eagle Lake Field Office
- Soda Mountains Wilderness Study Area, BLM California Desert Conservation Area

National Forest Wilderness

- Cucamonga Wilderness, San Bernadino National Forest
- Desolation Wilderness, Eldorado National Forest
- Ishi Wilderness, Lassen National Forest
- Mokelumne Wilderness, Eldorado National Forest

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National Forest Inventoried Roadless Areas

- Caples Creek Roadless Area, Eldorado National Forest
- Cajon Roadless Area, San Bernadino National Forest
- Circle Mountain Roadless Area, San Bernadino National Forest
- Cucamonga Roadless Area, San Bernadino National Forest
- Dardanelles Roadless Area, Lake Tahoe Basin Management Unit
- Fish Canyon Roadless Area, Angeles National Forest
- Freel Roadless Area, Lake Tahoe Basin Management Unit
- Grizzly Mountain Roadless Area, Plumas National Forest
- Heart Lake Roadless Area, Lassen National Forest
- Ishi Roadless Area, Lassen National Forest
- Magic Mountain Roadless Area, Angeles National Forest
- Middle Fort Feather River Roadless Area, Plumas National Forest
- Mill Creek Roadless Area, Lassen National Forest
- Red Mountain Roadless Area, Angeles National Forest
- Salt Creek Roadless Area, Angeles National Forest
- Salt Springs Roadless Area, Eldorado National Forest
- San Sevaine Roadless Area, San Bernadino National Forest
- Steele Swamp Roadless Area, Angeles National Forest
- Strawberry Peak Roadless Area, Angeles National Forest
- Tragedy-Elephant's Back Roadless Area, Eldorado National Forest
- Tule Roadless Area, Angeles National Forest
- West Fork Roadless Area, Angeles National Forest
- Wild Cattle Mountain Roadless Area, Lassen National Forest

National Parks

- Death Valley National Park
- Joshua Tree National Park
- Lassen Volcanic National Park
- Mojave National Preserve

State Parks

- Anza-Borrego Desert State Park

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On the Front Lines of California's Fight Against Global Warming



A Center for Biological Diversity Report

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Front cover photos:
Clockwise from top: US Fish and Wildlife Service,
Los Padres Forest Watch, Kassie Siegel

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The Center for Biological Diversity is a nonprofit
conservation organization with more than 35,000 members
dedicated to the protection of imperiled species and habitat.

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Photo courtesy Michael Mengak, www.forestryimages.org

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**The California Environmental Quality Act
On the Front Lines of California's Fight Against Global Warming**

SUMMARY

The State of California has long been a champion of environmental protection and a national leader in climate change policy. California has a number of laws and policies that address the critical challenge of slashing California's greenhouse gas emissions by mid-century. Prominent among these laws, but as yet little utilized, is California's flagship environmental protection statute, the California Environmental Quality Act (CEQA).¹ CEQA requires state and local agencies to assess and reduce to the extent feasible all significant environmental impacts from new project approvals. The CEQA environmental review process is fully established throughout the state, with a proven track record of mitigating impacts relating to air pollution, water quality and availability, land use, endangered species, and many other aspects of California's environment. With regard to climate change, CEQA offers an opportunity and a legal mandate for cities, counties, and government agencies to consider the greenhouse gas emissions from new projects they approve and to adopt the many measures available to reduce those emissions.

This paper describes the tremendous benefits to California from analyzing and reducing greenhouse gas emissions of new development through the CEQA process, and presents a blueprint for agencies and project applicants to address greenhouse gas emissions at each step in the CEQA review process. The assessment and reduction of greenhouse gas pollution through the CEQA process is one of our most important tools on the front lines of California's battle against global warming. For this reason, we encourage full implementation and enforcement of CEQA review of global warming impacts.

¹ Public Resources Code § 21000 et seq.; Cal. Code Regs., tit. 14, § 15000 et seq. ("CEQA Guidelines").

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I. GLOBAL WARMING: IMPACTS AND RISKS TO CALIFORNIA AND THE WORLD

Changes in the climate in California and throughout the world are painfully apparent. Changes already observed in California include warmer winter and spring temperatures; a smaller mountain snowpack that melts one to four weeks earlier in the spring; increased frequency and severity of droughts, floods, and wildfires; changes in plant and animal populations and ranges; and about seven inches of sea level rise.

The California Climate Change Center's summary report presents future impacts based on a low, medium, and high emissions scenario (Luers et al. 2006). In all impact categories from temperatures to heat related deaths to wildfire risk to loss of the Sierra snowpack, impacts become far worse under the medium and high warming scenarios. The low warming scenario presumes a rapid shift away from fossil fuels and towards clean and resource-efficient technologies.

In addition to impacts to California, the Intergovernmental Panel on Climate Change reports that global warming impacts are similar across the United States and worldwide (Adger 2007). The IPCC projects an increase in global average surface temperature by as much as 11.5 °F over the next 100 years; reductions in snow cover and permafrost; reductions in sea ice extent, with the arctic becoming ice-free in the summer in the second half of the century; increases in frequency of extreme heat and heavy precipitation events; an increase in the intensity of hurricanes; increases in the intensity of

EI Nino weather patterns; and changes in precipitation patterns, increasing or decreasing regionally by as much as 20% or more. These changes are predicted to displace millions of coastal residents, negatively impact public health, and lead to the catastrophic loss of biodiversity.

There is a large and growing body of economics literature on the environmental costs of climate change. For example, the Stern Review of the Economics of Climate Change (2006), a comprehensive report commissioned by the British government, concluded that if greenhouse gas emissions are unabated, each ton of carbon dioxide emitted today will cause damage worth at least \$85. Further, Stern (2006) warns that allowing current emissions trajectories to continue unabated would eventually cost the global economy between 5 to 20 percent of global gross domestic product (GDP) each year within a decade, or up to \$7 trillion, and that these figures should be considered conservative estimates. By contrast, measures to mitigate global warming by reducing emissions were estimated to cost about one percent of global GDP, or \$300 billion each year, and could save the world up to \$2.5 trillion per year (Stern 2006).

The severity of future global warming impacts is a collective societal choice: the longer it takes to reduce emissions, the worse the changes will be. Leading climate scientists warn that just ten more years of continued global "business as usual" greenhouse gas emissions will make it difficult or impossible to achieve the low warming scenario and avoid some of the worst impacts, including 20 feet of sea level

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rise in as little as a century, and the displacement of millions of coastal residents worldwide (Hansen et al. 2006, 2007). One scientific review determined that 35 percent of species may be committed to extinction by the year 2050 under a high emissions scenario (Thomas et al. 2004). Quite literally, continued unabated greenhouse gas emissions threaten life

on earth as we know it.

The importance of reducing greenhouse gas pollution cannot be overstated: reductions made today not only make economic sense, but will determine the type of climate and quality of life experienced by our children and grandchildren.

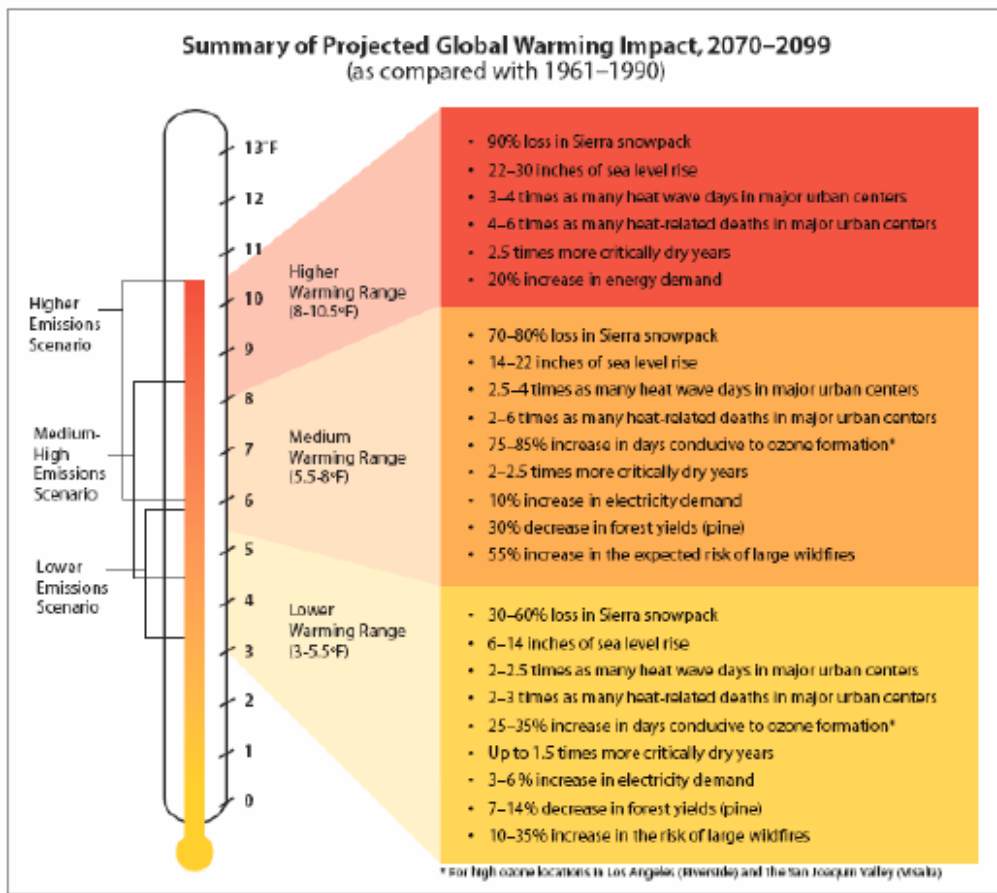


Figure from Luers et al. 2006.

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II. CALIFORNIA'S COMMITMENT TO FIGHTING GLOBAL WARMING

The significant risks climate change poses to California as well as the considerable benefits of reducing the State's greenhouse gas emissions have resulted in many laws and policies designed to reduce greenhouse gas emissions and increase energy efficiency and the use of renewable energy. These include California's Clean Vehicle Law (AB 1493, 2002), Governor Schwarzenegger's June 2005 Executive Order S-3-05, the California Global Warming Solutions Act of 2006 (AB 32, 2006), and many others.

California's Clean Vehicle law was implemented through a 2004 California Air Resources Board (CARB) rulemaking and would result in an 18% reduction in greenhouse gas emissions from California light-duty passenger vehicles by 2020 and a 27% reduction by 2030. These reductions would also be achieved, according to the CARB staff analysis, at a net benefit to the California economy.

The Governor's Executive Order established greenhouse gas emission targets as follows: by 2010, reduce emissions to 2000 levels; by 2020, reduce emissions to 1990 levels; and by 2050, reduce GHG emissions to 80 percent below 1990 levels. The Executive Order also established the interagency California Climate Action Team to coordinate the State's reduction efforts and report back on the progress of those efforts as well as the ongoing impacts of global warming on the State.

The California Global Warming Solutions Act of 2006 is the nation's first mandatory cap on a state's overall greenhouse gas emissions. The Act states:

Global warming poses a serious threat to the economic well-being, public health, natural resources, and the environment of California. The potential adverse impacts of global warming include the exacerbation of air quality problems, a reduction in the quality and supply of water to the state from the Sierra snowpack, a rise in sea levels resulting in the displacement of thousands of coastal businesses and residences, damage to marine ecosystems and the natural environment, and an increase in the incidences of infectious diseases, asthma, and other human health-related problems.

The Global Warming Solutions Act requires the reduction of emissions to 1990 levels by the year 2020. The law will be implemented through a series of CARB rulemakings including establishing emission source monitoring and reporting requirements, discrete early action emission reduction measures, and finally greenhouse gas emission limits and measures to achieve the maximum feasible and cost-effective reductions in furtherance of the greenhouse gas emission cap.

Solving our climate crisis requires action on many fronts and pursuant to many different laws and policies. California's important new laws and policies are in addition and completely complementary to the existing obligation of state and local agencies to analyze the

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greenhouse gas emissions from new project approvals pursuant to CEQA.²

Indeed, recognizing that CEQA provides an independent basis to combat global warming, the legislature recently passed SB 97 (2007), which requires the Office of Planning and Research to prepare by July 1, 2009, and the Resources Agency to certify by January 1, 2010, guidelines "for the mitigation of greenhouse gas emissions or the effects of greenhouse gas emissions as required by [CEQA], including, but not limited to, effects associated with transportation and energy consumption."

III. ASSESSMENT OF GREENHOUSE GAS EMISSIONS AND CLIMATE CHANGE UNDER CEQA

The CEQA environmental review process requires state and local agencies to analyze and disclose all significant environmental impacts of their discretionary project approvals. CEQA provides for varying levels of review based on the nature of the project's impacts. A Negative Declaration indicates that an initial study does not reveal any potentially significant environmental impacts. A Mitigated Negative Declaration indicates that potentially significant impacts exist but can be avoided or mitigated to below significance. Where there is a "fair

² For example, the Global Warming Solutions Act states repeatedly that "[n]othing in this division shall relieve any person, entity, or public agency of compliance with other applicable federal, state, or local laws or regulations, including state air and water quality requirements, and other requirements for protecting public health or the environment." *Health and Safety Code* § 38592(b); see also *id.* § 38598.

argument" that the project would have one or more significant environmental impacts, an Environmental Impact Report ("EIR") must be prepared (*Laurel Heights Improvement Ass'n v. Regents of Univ. of Cal.* [1993] 6 Cal.App.4th 1112, 1123; see also Pub. Res. Code § 21082.2).

An EIR is a documented review of the significant environmental effects of a project, possible ways to minimize those effects, and a comparison of alternative versions of the project. The purpose of the EIR is to inform agency decisions with regard to projects, to improve projects by reducing and mitigating environmental effects, and to inform the public and facilitate public input into the decisionmaking process. Once an agency has determined that a project's environmental effects will be significant, the agency cannot approve the project as proposed if there are feasible alternatives or feasible mitigation measures that will avoid or substantially lessen those effects (Pub. Res. Code § 21002). This paper focuses on the EIR process to disclose and analyze the project's greenhouse gas emissions.

A. Environmental Impacts Analysis

A project impact must be assessed if it has "an effect on the environment within the meaning of CEQA" (See *Protect the Historic Amador Waterways v. Amador Water Agency* [2004] 116 Cal.App.4th 1099, 1111). Global warming affects the "environment" as defined by CEQA³

³ CEQA defines "environment" as "the physical conditions which exist within the area which will be affected by a proposed project, including land, air, water, minerals, flora, fauna, noise, objects of historic or aesthetic significance." Pub. Res. Code § 21060.5.

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because global warming affects the physical conditions in all regions of California. Because a project that generates greenhouse gas emissions contributes to global warming, this impact must be fully disclosed and analyzed under CEQA.

In order to properly analyze a project's climate change impacts, an EIR should: 1) provide a regulatory and scientific background on global warming; 2) assess the project's contribution to climate change through an emissions inventory; 3) assess the effect of climate change on the project and its impacts; and 4) make a significance determination.

1. Providing a Scientific and Regulatory Background on Global Warming

As discussed above, climate change poses enormous risks to California. In order to assess a project's contribution to global warming, the EIR should provide an accurate and relevant summary of global warming and its impacts. The scientific literature on the impact of greenhouse gas emissions on California (and the world) is well developed and can provide the context for this discussion.⁴ The summary should make a good faith effort at full disclosure and avoid minimizing or discounting the severity of global warming's impacts (see CEQA Guidelines 14 C.C.R. § 15151; *San Joaquin Raptor/Wildlife Rescue Center v. County of Stanislaus* [1994] 27 Cal.App.4th 713).

⁴ Reports issued by California agencies are available at <http://www.climatechange.ca.gov> and IPCC reports available at <http://www.ipcc.ch/>.

The EIR should also include a brief discussion of other laws that address climate change, including California's mandate to reduce emissions to 1990 levels by 2020 and goal of further reducing emissions to 80% below 1990 levels by 2050. Achievement of state-mandated emissions reductions will be severely impeded if agencies across the state continue to approve new projects without incorporating measures to reduce the added emissions created by these projects.

2. Assessing the Project's Greenhouse Gas Emissions

To assess the project's greenhouse gas pollution, the EIR should complete an inventory of all of the project's emission sources. This inventory should include a "sufficient degree of analysis to provide decision-makers with information which enables them to make a decision which intelligently takes account of environmental consequences," and should include direct and indirect sources included in all phases of the project (CEQA Guidelines §§ 15151; 15126; 15358(a)(2)). The greenhouse gas inventory can be conducted in conjunction with the assessment of the project's energy consumption, required by Pub. Res. Code § 21100(b)(3) (see also CEQA Guidelines § 15126.4).

While the exact contents of an inventory will vary depending on the project considered, sources to consider include the following:

- Electricity and natural gas usage in buildings;
- Vehicle trips generated by the project;

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- Water supply and transportation to the project;
- Operation of construction vehicles and machinery;
- Manufacture and transport of building materials;
- Waste disposal, including transport of solid waste and methane emissions from organics decomposition;
- Process emissions, such as from the production of cement or the refining of gasoline;
- "End use" emissions, such as the burning of the fossil fuels extracted by a production project;
- Agricultural processes, including methane from concentrated animal manure;
- Fugitive emissions, such as methane leaks from pipeline systems and leaks of HFCs from air conditioning systems.

A project's greenhouse gas emissions can be measured through a variety of straightforward inventory methodologies including protocols from the California Air Resources Board, the California Climate Action Registry, the California Energy Commission, U.S. Environmental Protection Agency, Intergovernmental Panel on Climate Change, and non-governmental organizations. Inventory methodologies are listed in the Appendix of this paper.

3. Assessing the Effect of Global Warming on the Project and the Project's Impacts

The EIR should discuss how climate change will affect the project and its

impacts. For example, a development project in a coastal area may be subject to flooding based on projected sea level rise. In addition, global warming may exacerbate or change a proposed project's impacts. Dewatering of rivers by pumping will be much more significant if surface flows are reduced by global warming; higher air temperatures will increase the formation of ground level ozone; and species at risk from temperature increases and changes in precipitation will be more sensitive to project impacts to their habitats. In sum, global warming may exacerbate a project's impacts or reduce the effectiveness of mitigation measures to reduce those impacts, and the EIR should include a discussion of these dynamics.

4. Making a Significance Determination

After disclosing and analyzing a project's greenhouse gas emissions, the agency must determine whether the impacts from those emissions are significant (Pub. Res. Code § 21082.2). A lead agency must determine not only whether a project's impacts will be significant in and of themselves, but also whether the impact will be significant on a cumulative basis. A project's impacts require a mandatory finding of significance if they are "cumulatively considerable" (Pub. Res. Code § 21083(b)). "Cumulatively considerable" means that the incremental effects of an individual project are significant when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects" (CEQA Guidelines § 15064(h)(1)).

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Climate change is a classic example of a cumulative effects problem: emissions from numerous sources combine to create the most pressing environmental and societal problem of our time. These sources may appear insignificant when considered individually, but assume threatening dimensions when considered collectively with other sources with which they interact (see *Los Angeles Unified School Dist. v. City of Los Angeles* [1997] 58 Cal.App.4th 1019, 1025). The solution to climate change lies not in any one single action, but in systematically reducing emissions from all possible sources.

While a particular project's greenhouse gas emissions represent a fraction of California's total emissions, courts have flatly rejected the notion that the incremental impact of a project is not cumulatively considerable because it is so small that it would make only a *de minimis* contribution to the problem as a whole (see *Communities for a Better Environment v. California Resources Agency* [2002] 103 Cal.App.4th 98, 117).⁵ An EIR may not use the magnitude of a current problem to trivialize the project's impacts (see *Kings County Farm Bureau v. City of Hanford* [1990] 221 Cal.App.3d 692, 719). Rather, "the greater the existing environmental problems are, the lower the threshold should be for treating a project's contribution to cumulative

⁵ See also *Massachusetts v. EPA*, 127 S.Ct., 1438, 1457 (2007) (U.S. Environmental Protection Agency arguments for not regulating carbon dioxide from vehicles under the Clean Air Act "rests on the erroneous assumption that a small incremental step, because it is incremental, can never be attacked in a federal judicial forum [...] Agencies, like legislatures, do not generally resolve massive problems in one fell regulatory swoop.").

impacts as significant" (see *Communities for a Better Environment* 103 Cal.App.4th at 120). In light of the magnitude and scope of the climate change impacts facing California and the mandate of both the California Global Warming Solutions Act of 2006 and Executive Order S-3-05 that existing levels of greenhouse gases be significantly reduced, any new emissions generated by a project should be considered cumulatively significant.

Consistent with CEQA's treatment of cumulative impacts, lead agencies have explicitly determined that *any* increase in greenhouse gases above existing levels is a significant impact under CEQA (see *Marin Countywide Plan Update DEIR*, 2007; *San Diego Ass'n of Governments Regional Transportation Plan DEIR*, 2007). Other agencies have declined to make a significance determination on global warming impacts based on the assertion that doing so would be "speculative." In the case of climate change, there is nothing speculative about the fact that: 1) new sources of greenhouse gases add to existing levels; and 2) the state has determined existing levels are unacceptable and must be reduced within a fixed timeframe.

Moreover, even where there is no universally accepted methodology as to what constitutes a significant impact, a lead agency must still meaningfully attempt to quantify a particular impact and determine whether the impact is significant (see *Berkeley Keep Jets Over the Bay Committee v. Board of Port Commissioners* [2001] 91 Cal.App.4th 1344, 1370-71. Accordingly, the lack of established greenhouse gas thresholds does not

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shield a lead agency from making a significance determination on global warming impacts. Because the legislature has determined that California's current greenhouse gas baseline is so high that it requires significant reductions, and any additional emissions will exacerbate existing conditions, it is difficult to see how a new source, even a small one, can be cumulatively insignificant.

Because additional greenhouse gas emissions from new projects will nearly always qualify for a mandatory finding of significance under CEQA as a cumulative impact, an agency's determination of whether the emissions should be considered significant in and of themselves may assume less importance as a practical matter. While the authors believe that agencies should consider emissions from large projects significant in their own right as well as cumulatively, agencies will exercise their discretion in this regard and further clarification will likely come in the form of case law or guidance.

It does not follow from this analysis, however, that every project that generates greenhouse gas emissions will require an EIR. As with any other potentially significant impact, the project may include measures to reduce the impact of greenhouse gas emissions to below significance, allowing for a Mitigated Negative Declaration (Pub. Res. Code § 21064.5). As discussed below, there are many mitigation measures available for housing and other types of projects that can do so.

B. Evaluation of Alternatives

A rigorous analysis of alternatives is essential to avoid or substantially lessen environmental impacts in the first instance (Pub. Res. Code § 21002; CEQA Guidelines §§ 15002(a)(3), 15021(a)(2)). "Without meaningful analysis of alternatives in the EIR, neither courts nor the public can fulfill their proper roles in the CEQA process" (*Laurel Height Improvement Ass'n v. Regents of University of California* [1988] 47 Cal.3d 376, 404). With regard to development projects, an EIR should examine alternatives that call for higher density development, mixed use, and site locations in urban areas that would reduce vehicle miles traveled. In the case of fossil fuel related energy projects, an EIR should examine the feasibility of energy generation utilizing renewable energy sources. Impacts should be avoided wherever possible through the adoption of environmentally superior alternatives.

C. Adoption of Feasible Mitigation Measures

Mitigation of a project's significant impacts is one of the "most important" functions of CEQA (*Sierra Club v. Gilroy City Council* [1990] 222 Cal.App.3d 30, 41). Once an agency has determined that a project's greenhouse gas emissions will be significant, the agency cannot approve the project as proposed if there are feasible alternatives or feasible mitigation measures that will avoid or substantially lessen the project's significant environmental effects (Pub. Res. Code § 21002).

The applicability of mitigation for global warming impacts was recognized by the

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legislature in SB 97, which sets a deadline of January 1, 2010, for the Resources Agency to certify and adopt guidelines developed by the Office of Planning and Research "for the mitigation of greenhouse gas emissions as required" by CEQA. While SB 97 clarifies that the legislature considers global warming to be an impact requiring mitigation under CEQA, nothing in SB 97 postpones or defers the current obligation of agencies to mitigate greenhouse gas emissions from proposed projects prior to the adoption of guidelines by the Resources Agency.

Agencies should utilize a hierarchy of options to avoid and reduce greenhouse gas emissions before moving on to other types of mitigation. For example, with regard to energy use, the agency should first look at reducing the energy required by the project, then at measures to generate the remaining energy from renewable sources, then at measures to offset any remaining energy related emissions. (See Pub. Res. Code § 21100(b)(3); CEQA Guidelines, App. F; see also *Anderson First Coalition v. City of Anderson* [2005] 130 Cal.App.4th 1173). Measures to reduce climate change impacts may not be deferred until some future time or be so vague that it is impossible to evaluate their effectiveness (see CEQA Guidelines § 15126.4(a)(1)(B)).

While the specific array of feasible mitigation measures varies with the diversity of project proposals in California, there is a common suite of avoidance and mitigation measures for many types of projects. Below we discuss two of the most common project types, proposals for new residential or

commercial buildings and municipal general plans.

1. Avoiding and Mitigating a Building Project's Greenhouse Gas Emissions

California has access to nearly year-round sunshine in vast areas of the state and already has more stringent energy efficiency requirements than the rest of the nation as a whole. This has placed our state in an enviable position: by increasing green building practices, it is feasible today to build many structures with vastly reduced energy needs for heating, cooling, lighting, and other needs. Mitigation measures agencies should consider include the following:

- Constructing highly energy-efficient buildings to decrease heating, cooling, and other energy demands, including using passive heating, natural cooling, and reduced pavement;
- Utilizing high-efficiency heating and cooling systems, lighting devices, and appliances;
- Minimizing and recycling construction-related waste;
- Using salvaged and recycled-content materials, and other materials that have low production energy costs, for building materials, hard surfaces, and non-plant landscaping;
- Maximizing water conservation measures in buildings and landscaping;
- Installing photovoltaic solar energy arrays on buildings to meet energy needs;

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- Installing solar hot water systems to meet hot water needs; and
- Cooperating with local transportation agencies to secure public transportation, and contributing to public transportation infrastructure.

2. Mitigating a Municipal Plan's Greenhouse Gas Emissions

The adoption and updating of municipal general plans and transportation plans offer exceptional opportunities to examine the impact of agency planning and policy on greenhouse gas pollution and to adopt measures to reduce that pollution. Mitigation measures incorporated into these multi-year plans would not only reduce the greenhouse gas emissions and global warming impacts of the plans, but facilitate the development of future projects with lower impacts and greater opportunities for mitigation. For example, municipal plans can include provisions for:

- Expanded public transportation service and infrastructure, such as bus and light rail lines;
- Energy efficiency/green building requirements, adopted via ordinances, codes, and regulations;
- Installation of electric vehicle charging stations;
- Expanded infrastructure for pedestrian and bicycle circulation;
- Public awareness and education programs;
- Conversion of state, local, and private fleets to alternative fuel vehicles, and requirements and incentives for fleets to run on alternative fuels;

- Capture and control of methane from municipal landfills and composting facilities; and
- Incentives to focus housing development along existing travel corridors, urban areas, and as in-fill.

3. Offsetting Greenhouse Gas Emissions

Once all measures to avoid and minimize greenhouse gas emissions have been adopted, the project will need to offset the remaining greenhouse gas emissions. Offsets are a type of offsite mitigation in which the greenhouse gas emissions of the project are balanced by an action to reduce greenhouse gas emissions elsewhere. Credit is given in the amount of emissions avoided or sequestered by the offsite project. It is critical that offsets be real, verifiable, and permanent, and not have adverse impacts on communities or the environment. For example, offsets can include a retrofit of previously existing buildings in the project area to make them more energy efficient, or the installation of photovoltaic arrays or solar water heating systems on offsite buildings.

However, offsite mitigation and offsets should be pursued only after all feasible onsite actions have been undertaken to maximally avoid and reduce the project's greenhouse gas emissions. Furthermore, any offsite mitigation should give the highest priority to offsets within California in order to contribute to state-wide greenhouse gas emissions reductions and to help ensure that the offsets comply with California environmental laws and emissions standards.

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D. Statements of Overriding Considerations

If a proposed project will still have a significant impact on the environment after all feasible alternatives and avoidance and mitigation measures have been adopted, an agency may still approve the project if it adopts a "Statement of Overriding Considerations" (CEQA Guidelines § 15092). Thus, CEQA does not prevent agencies from approving new sources of greenhouse gas emissions, it simply provides a time-tested mechanism for agencies to explore and adopt options to reduce greenhouse gas emissions. It also serves an important informational purpose – the public and decision-makers can track a jurisdiction's approach to greenhouse gas reductions and the success of that approach through the CEQA process. CEQA will continue to illuminate, as the Legislature intended, the way that local elected officials balance factors, including the environment and greenhouse gas emissions, in their project approvals.

IV. CONCLUSION

The solutions to climate change are multi-faceted, including the need for a federal commitment to reducing greenhouse gas emissions, a world-wide transition away from fossil fuels and towards renewable and low-carbon energy sources, and a general adoption of all possible means of systematically reducing emissions from all sources. These challenges will be made even more difficult if we continue to engage in land use and planning decisions that do not take global warming into account.

The solutions to climate change, then, are also highly local. In California we are extremely fortunate to already have an established and straightforward mechanism for evaluating and ameliorating the greenhouse gas emissions from local project approvals. Taking full advantage of the CEQA review process to do so will continue to be an important and integral part of solving the climate crisis.

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Comment Set B0041, cont.
Center for Biological Diversity/Sierra Club

The California Environmental Quality Act
On the Front Lines of California's Fight Against Global Warming

**APPENDIX: METHODOLOGIES FOR CALCULATING A PROJECT'S
GREENHOUSE GAS EMISSIONS**

The following resources are available for calculating a project's greenhouse gas emissions. No single protocol will necessarily fulfill CEQA's requirement to assess all of a project's direct and indirect emissions. It may be necessary to combine more than calculation protocol to include all of the project's impacts.

- The California Climate Action Registry, <http://www.climateregistry.org/>, is developing inventory protocols for many greenhouse gas emission sources, including: electricity use; motor vehicles; stationary combustion sources such as power plants, refineries, manufacturing processes, and furnaces; purchased steam, heat, and power from co-generation plants; fugitive emissions; cement manufacturing; forestry operations; and livestock operations.
- The California Energy Commission 2006 "*Inventory of California Greenhouse Gas Emissions and Sinks: 1990-2004*," Appendix B, describes methodologies for the calculation of CO₂ and methane emissions from a variety of sources. The report is available at: http://www.climatechange.ca.gov/policies/greenhouse_gas_inventory/index.html;
- The California Air Resources Board has developed the *EMission FACTors (EMFAC)* model computer program to calculate CO₂ and methane emissions from motor vehicles. The model and data are available at: http://www.arb.ca.gov/msei/onroad/latest_version.htm.
- The U.S. Environmental Protection Agency 2007 "*Inventory of U.S. greenhouse gas emissions and sinks: 1990-2005*" provides an inventory of greenhouse gas emissions by state, and methodologies for estimating CO₂, methane and N₂O emissions from a variety of sources. The report is available at: <http://www.epa.gov/climatechange/emissions/usinventoryreport.html>.
- The U.S. Environmental Protection Agency provides a clearinghouse of online programs for calculating greenhouse gas emissions from homes and businesses, motor vehicles, and solid waste, and for converting emissions to CO₂ equivalents. The clearinghouse is available at: <http://yosemite.epa.gov/oar/globalwarming.nsf/content/ResourceCenterToolsCalculators.html>.
- The U.S. Environmental Protection Agency Climate Leaders Program offers a *Greenhouse Gas Inventory Protocol* based on the Greenhouse Gas Protocol (GHG Protocol) developed by the World Resources Institute and the World Business Council for Sustainable Development Emissions Inventory Improvement Program. The program and documents are available at: <http://www.epa.gov/climateleaders/resources/index.html>.
- The Intergovernmental Panel on Climate Change 2006 *Guidelines for National Greenhouse Gas Inventories* provides methodologies for calculating greenhouse gas emissions from energy production, transport, and use; industrial processes and product use; agriculture, forestry, and other land use; solid waste and wastewater treatment. The guidelines are available at <http://www.ipcc-nggip.iges.or.jp/public/2006gl/index.htm>.
- World Resources Institute and the World Business Council for Sustainable Development (WRI/WBCSD) provide standards and guidance for a greenhouse gas emissions inventory, covering the six greenhouse gases covered by the Kyoto Protocol--CO₂, methane, N₂O, hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulphur hexafluoride (SF₆). The protocols are available at <http://www.ghgprotocol.org>.

Comment Set B0041, cont.
Center for Biological Diversity/Sierra Club

**BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF CALIFORNIA**

In the Matter of the Application of San Diego Gas & Electric Company (U 902-E) for a Certificate of Public Convenience and Necessity for the Sunrise Powerlink Transmission Project	Application 06-08-010 (Filed August 4, 2006)
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**PHASE I DIRECT TESTIMONY
OF DR. BARRY BUTLER
ON BEHALF OF CONSERVATION GROUPS**

Justin Augustine
Steven Siegel
Center for Biological Diversity
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Dated: June 1, 2007

Comment Set B0041, cont.
Center for Biological Diversity/Sierra Club

Testimony of Dr. Barry Butler on Dish/Stirling Solar Technology

1. INTRODUCTION

My name is Barry L. Butler, PhD. As more fully outlined in my resume, Appendix A, I have a PhD in Materials Science and am the former vice president and manager of SAIC's Solar Energy Products Division. I joined the Solar Energy Research Institute, the predecessor to the National Renewable Energy Laboratory, in 1978, soon after it began operations. Prior to that time I worked at Sandia National Laboratory specializing in solar optical materials. I wrote the chapter on cooperative solar thermal commercialization activities in the book "Implementation of Solar Thermal Technology" published by MIT Press in 1996. I have written or co-authored over 10 technical papers on all aspects of dish/Stirling solar technology development. I was the president of the Concentrating Solar Power Division of the Solar Energy Industries Association from 1998 to 2002, and I am the owner of Butler Sun Solutions, a firm specializing in the design and sales of solar hot water heating systems.

2. BACKGROUND

San Diego Gas and Electric (SDG&E), a company owned by Sempra Energy, has filed an application to the CPUC claiming a 150 mile, 1000 MW transmission line is needed to import energy into San Diego County to ensure the reliability of the regional transmission system on peak demand days, and has further suggested the transmission line is needed to encourage the development of renewable power in Imperial Valley. SDG&E has signed a power purchase agreement (PPA) with Stirling Energy Systems (SES), Phase I of which is for a 300 MW dish/Stirling array, a total of 12,000 of their 25

Comment Set B0041, cont.
Center for Biological Diversity/Sierra Club

Testimony of Dr. Barry Butler on Dish/Stirling Solar Technology

kW dish/Stirling systems, in Imperial County that must be delivered in increments between 2008 and 2010, as is stated in the CPCN (p. III-11):

The Agreement with SES contemplates the purchase by SDG&E of up to 900 MW of new solar related energy from SES in three phases. Phase 1 consists of 300 MW scheduled for delivery in the 2008 to 2010 timeframe. While the first phase will provide 300 MW when all construction is completed, the capacity will be added in increments over the 2008 through 2010 period. Phase 2 project consists of an additional 300 MW in the 2011 to 2012 timeframe. SDG&E also has a right of first refusal for a third phase for another 300 MW phase.

According to the SDG&E, commercial production is expected to begin in 2008. The economic terms of the contract, specifically the \$/kwh price that SDG&E will pay SES for the power, is unknown.

There are currently six prototype 25 kW Stirling dishes in operation at Sandia National Laboratory. I have been asked to opine on the reliability and cost of SES dish technology and whether it is feasible or realistic to expect that SES can meet the contract schedule defined by SDG&E.

3. DEVELOPMENT HISTORY OF DISH STIRLING TECHNOLOGY

I co-authored a 2003 paper that includes a brief history of the development of dish Stirling technology.¹ I have excerpted the following summary of dish Stirling technology from that paper.

Over the last 20 years, eight different Dish-Stirling systems ranging in size from 2 to 50 kW have been built by companies in the United States, Germany, Japan, and Russia. The first of the historical systems, the 25-kW Vanguard system built by ADVANCO in Southern California, achieved a reported world record net solar-to-electric conversion efficiency of 29.4%. In 1984, two 50-kW Dish-

¹ T. Mancini, P. Heller, B. Butler, B. Osborn, W. Schiel, V. Goldberg, R. Buck, R. Diver, C. Andracka, J. Moreno, *Dish-Stirling Systems: An Overview of Development and Status*, Journal of Solar Energy Engineering, Vol. 125, pp. 135-151, May 2003.

Comment Set B0041, cont.
Center for Biological Diversity/Sierra Club

Testimony of Dr. Barry Butler on Dish/Stirling Solar Technology

Stirling systems were built, installed, and operated in Riyadh, Saudi Arabia, by Schlaich-Bergermann und Partner of Stuttgart, Germany.

A third Dish-Stirling system was built by McDonnell Douglas Aerospace Corporation (MDAC) in the mid 1980s and, when MDAC discontinued development of the technology, the rights to the system were acquired by the Southern California Edison Company (SCE). SCE operated the system from 1985 to 1988. Stirling Energy Systems (SES) of Phoenix, Arizona, acquired the technology rights and system hardware in 1996 and have continued development of the system. In 1991, Cummins Power Generation, working under costshared agreements with the U.S. Department of Energy and Sandia National Laboratories, started development of two Dish-Stirling systems: a 7-kW system for remote applications and a 25-kW system for grid-connected power generation. Cummins was innovative in its Dish-Stirling systems, incorporating advanced technologies into the designs. . . The two Cummins programs made progress, but were terminated in 1996 when Cummins' parent company, Cummins Engine Company, realigned business along its core area of diesel engine development.

Dish-Stirling systems have demonstrated that they are capable of producing electricity for the grid and for remote power applications. Technology development needs are for low-cost components and systems that can operate unattended at very high levels of reliability.

SES acquired the intellectual and technology rights to the McDonnell Douglas concentrator and the license to manufacture the USAB (now Kockums) 4-95 Stirling engine based power conversion unit (PCU) in 1996.

The (SES) systems are continuously monitored and repaired whenever a problem occurs. Consequently, they have demonstrated excellent availability, greater than 98%, during the most recent 1,000 hr of operation.

I was the SAIC project manager for a dish/Stirling design that was in competition with the SES design. By 2002, SAIC had also demonstrated relatively high availability of the system for periods of time. However, the "mean time between failure" was approximately 40 hours. Major reliability problems with the SAIC Stirling engine included hydrogen leakage through joints and seals, internal engine seal leakage, swashplate actuator stalls, and heater head braze joint hydrogen leaks. That means that

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Testimony of Dr. Barry Butler on Dish/Stirling Solar Technology

on average once every 40 hours a problem of some type required shut down and maintenance. Nearly continuous maintenance was necessary to keep the system “available” to generate electricity. SES has also demonstrated very high availability, though this has been achieved by a program of continuous maintenance. In 2002, SES and SAIC both had dish/Stirling units operating at the University of Nevada – Las Vegas. Power output was greater for SES than SAIC. Both SAIC and SES conducted maintenance on a nearly continuous basis to keep the units available for electricity production.

Dish/Stirling is not cost-competitive with conventional power generation, or other forms of renewable power generation such as wind and solar, at this time. Wind and geothermal are fully commercial renewable energy technologies with a cost of energy of approximately 5¢ US/kWhr each.² As noted in the 2003 Journal of Solar Energy Engineering paper I co-authored:³

In the U.S., niche markets for Dish-Stirling power generation depend on federal or state government subsidies, required to close the gap between the current cost of power from these systems (~30¢ US/kWhr) and the price that the market is willing to pay (~6¢ US/kWhr), a difference of 24¢ US/kWhr.

Even at the relatively low production rate of 50 MW/yr (~2,000 25-kW systems or 5,000 10-kW systems) and at an O&M cost of 1–2¢/kWhr, the cost of electricity from Dish-Stirling systems will be 15–20¢/kWhr enabling entry into some village and remote-power markets. As system costs fall and reliability improves, it is reasonable to expect levelized energy costs of less than 10¢

² R. Caputo, B. Butler, *Solar 2007: The Use of “Energy Parks” to Balance Renewable Energy in the San Diego Region*, accepted for publication, American Solar Energy Society, 2007 Annual Conference, Cleveland, July 2007.

³ T. Mancini, P. Heller, B. Butler, B. Osborn, W. Schiel, V. Goldberg, R. Buck, R. Diver, C. Andraka, J. Moreno, *Dish-Stirling Systems: An Overview of Development and Status*, Journal of Solar Energy Engineering, Vol. 125, pp. 135-151, May 2003., p. 139.

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Testimony of Dr. Barry Butler on Dish/Stirling Solar Technology

US/kWhr, which will expand the markets to distributed generation and demand-side applications.

A “mean time between failure” between 2,000 and 10,000 hours must be proven before dish/Stirling can be incorporated into utility-scale installations.⁴ The current “mean time between failure” is a few hundred hours. This means a great deal of time, effort, and money must be spent on maintenance. This drives up the cost of operating a dish/Stirling unit. The commercial viability of the Stirling system is unproven at this time.

**4. PILOT INSTALLATION IS NEXT LOGICAL STEP IN
DISH/STIRLING DEVELOPMENTAL PROGRESSION**

The 1 MW pilot project being developed by SES for SCE is a good example of a necessary and prudent incremental step to ensure all the technical deficiencies in the first generation production model are worked-out before scaling-up to arrays involving many 1,000s of individual dishes. It is also instructive that SCE, a company with extensive experience with dish/Stirling technology and the company that sold the technology to SES, is requiring the successful deployment of a 1 MW pilot project before scaling-up to a utility-scale installation.

SDG&E has no experience with the operation of dish/Stirling technology, and is proposing to go straight from the prototype to a utility-scale installation. Few or none of the benefits of the 1 MW pilot test will be available to SES as it moves to full commercial scale production to satisfy the SDG&E contract(s), as the 1 MW pilot has not yet begun operation and full commercial production must begin in a matter of months if SES hopes

⁴ R. Caputo, B. Butler, *Solar 2007: The Use of “Energy Parks” to Balance Renewable Energy in the San Diego Region*, accepted for publication, American Solar Energy Society, 2007 Annual Conference, Cleveland, July 2007.

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Testimony of Dr. Barry Butler on Dish/Stirling Solar Technology

to meet the 2010 deadline established in the SDG&E contract. This is neither prudent nor possible unless the technical risks of the operation and maintenance are quantified and then apportioned between the federal government, investors, SES and SDG&E. The SCE 1MW project is the way to quantify the risks, before moving to 10MW then on to 100MW. Without these risks quantified and apportioned, investors who are willing to shoulder all of the risks for a meager reward must be found.

5. DISH/STIRLING IS A PRE-COMMERCIAL TECHNOLOGY

The San Diego Regional Renewable Energy Study Group addressed dish/Stirling in its August 2005 *Potential for Renewable Energy in the San Diego Region*.⁵ Several of the co-authors of this report are SDG&E staff. Dish/Stirling is identified as pre-commercial in this study, based primarily on analyses conducted by the National Renewable Energy Laboratory and Black & Veatch.

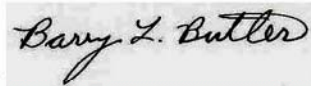
I concur with this assessment in the *Potential for Renewable Energy in the San Diego Region*. My opinion is that dish/Stirling technology holds much promise. By 2020, the technology could be a significant player on a commercial scale in the concentrated solar power category. However, there is no possible way that dish/Stirling solar can move from high cost prototype models with substantive reliability concerns to large-scale production of high reliability low-cost commercial models by 2008 and full operation of a 12,000 dish, 300 MW array by the end of 2010. An entire step wise development 1MW, 10MW, 100MW with installed cost, reliability and operation & maintenance costs assessed over a year of operation at each step is necessary to move

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Center for Biological Diversity/Sierra Club

Testimony of Dr. Barry Butler on Dish/Stirling Solar Technology

from current prototypes to the large-scale commercial plants contemplated in the power purchase agreements between SDG&E and SES.

I declare under penalty of perjury this testimony and attachment are, to the best of my knowledge, true and correct.



Signed:

Date: 5/31/2007

Barry L. Butler, PhD
811 Academy Dr.
Solana Beach, CA 92075
858-259-8895

⁵ San Diego Regional Renewable Energy Study Group, *Potential for Renewable Energy in the San Diego Region*, August 2005 (www.renewablesg.org).

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APPENDIX A

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BARRY L. BUTLER, Ph. D.

EDUCATION

B.S. Ceramic Engineering, 1965, Alfred University
M.S. Materials Science, 1967, Rensselaer Polytechnic Institute
Ph.D. Materials Science, 1969, Rensselaer Polytechnic Institute

MANAGEMENT TRAINING

1980 Experience Compression Lab/Interpersonal skills training
1981 Technical Writing, short course, University of Denver
1982 Management Action Program/Management Methods
1983 Personal Management Skills, University of Denver

PROFESSIONAL SUMMARY

Dr. Butler has lead nationally recognized teams in solar materials technology for US/DOE, and solid rocket motor propellant to case bonding for NASA. In addition to guiding the national teams and managing the work, he also represented the teams' work to the legislature and Executive branches of government to illustrate their importance.

Dr. Butler is a material scientist with training in the structure property relationships of metals, ceramics and polymers. Dr. Butler has contributed to the basic understanding of carbon/carbon and carbon/polymer composite materials. His research on the optical properties of low cost, lightweight optical structures has helped to relate material properties to system performance. Dr. Butler developed the laser ray trace optical evaluation technique for determining the slope errors of new and available solar concentrators. He guided the development of the solar thermal technology at Solar Energy Research Institute (SERI) which included major advances in stressed membrane heliostats and direct absorption thermal receivers.

As manager of SAIC's Energy Products Division he has managed the design, fabrication and deployment of five 25 kWe dish/engine power systems. Each 114m² reflector weighs 18,000 lbs., and are capable of self-deployment. Dr. Butler holds nine patents and has one pending patent application for the self-deploying advanced drive.

As the manager of the NASA Solid Propulsion Integrity Program (SPIP) Bondline work package of Science Applications International Corporation (SAIC), he was responsible for evaluation of materials and processes to improve the reliability of space shuttle solid rocket motors. Large composite glass/graphite epoxy solid rocket motor cases were health monitored and verified during manufacture, cure and pressure test. He was responsible for managing research and development and enhancing innovation and engineering applications of activities. The NASA SPIP program's \$70M effort was documented on a CD-ROM database a first for NASA. He is active in both the Solar Energy Industries Association (SEIA) and congressional liaison work for solar and aerospace activities.

Comment Set B0041, cont. Center for Biological Diversity/Sierra Club

As the manager of the Energy Projects Division at SAIC, he has played a major role in the development of electro-chemical battery systems and membrane heliostat technology. He has planned and expanded SAIC's battery systems development to include sodium sulfur cells for utility load-leveling and electric vehicle applications and other advanced cells and systems for aerospace applications. He planned and expanded SAIC's advanced solar concentrator area to include design, fabrication and testing of advanced heliostat and dish systems to meet customer needs. He has moved to extend both heliostat and dish technology into small, lightweight modular systems capable of acquisition by a broader range of customers. As Vice President of the Solar Energy Industries Association (SEIA) during 1995 and President during 1996, he drafted the SEIA Strategic Plan and prepared congressional testimony on solar thermal technology representing the industry to congressional committees. He supported the Department of Energy (DOE) solar Thermal Five Year Plan and represented industry to the Office of Management and Budget (OMB) on solar funding issues.

As a research manager at SERI, he guided the research of 90 scientists (\$15 million annually) on solar materials, heat and mass transfer, and thermal systems. Building heating and cooling, ocean thermal energy conversion, solar thermal electric and industrial process heat programs have also been under his direction. Dr. Butler has set the pace in advanced lightweight solar collectors with two patentable concepts. He has also recognized and supported significant advancements in materials and designs from his research staff. He has defined, packaged and sold research programs based on these concepts. Several programs have resulted in commercial products.

He has developed research management skills which allow creativity and technical freedom, while maintaining tight cost and schedule control to ensure quality and timely technical outputs. He is multilingual, has traveled internationally for the Fulbright Foundation, and has lectured on solar materials.

EXPERIENCE

Started Butler Sun Solutions-2002-Present

He runs the solar manufacturing operation for patented solar assisted hot water system. They also perform contracted services to support large 160 m² advanced tracker drives for commercial solar companies. They also are doing engineering management and configuration control for the 250,000 gallon per day desalination plant for the City of Avalon, on Catalina Island, CA, in conjunction with Southern California Edison.

Manager, Energy Products Division for SAIC, 1996- 2002

Dr. Butler ran the United States Department of Energy Dish/Stirling Joint Venture Program. A \$36 million 50/50 government industry cost share program to develop and deploy dish/engine systems. To date, three systems have been deployed and are operating at design levels.

Manager, NASA Solid Propulsion Integrity Program Bondline Division for SAIC, 1989-1996

He was a major contributor to the SAIC proposal and designated as the program manager for the \$40 million, seven year effort. He staffed and set up the Bondline Program offices in San Diego, California, and Huntsville, Alabama. He managed ten SAIC staff and \$5 million annually. He managed the Bondline team consisting of six major subcontractors; Thiokol, Hercules, United Technologies (CSD), ARC, Lockheed Martin, and Aerojet. His division managed the cost, schedule, and technical content of the program. He was responsible for overall customer (NASA) satisfaction.

Comment Set B0041, cont. Center for Biological Diversity/Sierra Club

Manager, Energy Projects Division, Science Applications International Corporation, 1984 – 1988

He started the energy Projects Division which has grown to include 10 staff members and \$1.2 million in annual sales while meeting both growth and profit objectives. The division performs research on point and line focus solar collectors, advanced electrochemical storage batteries and chemical conversion of phosphogypsum to sulfur. He managed systems research and simulations as well as hardware development and testing. He has motivated his division staff to be creative and achievement-oriented, which has enabled business growth.

Manager, Solar Thermal and Materials Research Division, Solar Energy Research Institute, 1982 – 1984

As the manager of the Solar Thermal and Materials Research Division, he directed the activities of the division and developed new technical initiatives, management policies, and operating procedures. He was responsible for managing the Solar Thermal, Passive, Active, Buildings, Conservation and Ocean Programs. Specifically, he managed four research branches: Thermal Research, Materials Research, Thermal Systems and Engineering Research, and Buildings System Research. The division totaled 90 people and \$15 million in research funds annually.

Manager, General Research Division, Solar Energy Research Institute, 1980 – 1982

Dr. Butler managed the General Research Program (\$10 million and 60 staff) which included basic research tasks in photochemistry, photoelectrochemistry, remote sensing of solar resources, university grants (26), sabbatical and summer intern programs, nondestructive evaluation, optical materials and containment materials research. He instituted research reporting of technical progress and cost control on a monthly basis

Chief, Materials Branch, Solar Energy Research Institute, 1978 – 1980

Dr. Butler built and managed the Materials Branch from a staff of four to thirty people supported by a budget of \$3 million annually. He developed the facilities and equipment needs of the branch. He conceived and implemented the Solar Optical Materials Planning Committee composed of representatives of Sandia Lab Albuquerque, Sandia Lab Livermore, Jet Propulsion Lab, Los Alamos National Lab, Battelle Pacific Northwest Lab, Lawrence Berkeley Lab, National Bureau of Standards, and SERI. The committee publishes a set of National Solar Materials Planning Recommendations in five reports which have been followed by the DOE research program.

Solar Materials Coordinator, Sandia National Laboratory, 1975 – 1978

Dr. Butler coordinated the materials and process support of Solar Total Energy, Central Receiver and Photovoltaic projects. This included development of advanced collector testing based on laser ray tracing, materials research on the outdoor durability of wood and composites and life testing of this glass, wood, and composites. Large-scale materials field testing and hail damage test facilities were also part of his responsibility.

Member, Technical Staff, Sandia National Laboratory, 1969 – 1975

He conducted research and published work on advanced carbon/carbon structure property relationships. This research formed the basis for process changes which supported five successful test flights of

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carbon/carbon heat shields. Thermally induced strains and stresses up to 2800°C were studied and modeled to determine composite behavior under transient thermal loading. Carbon fiber felts and filament would performers were densified by chemical vapor deposition and carbonized pitch matrix methods. Nose tips heat shields and thermal insulation systems were fabricated and studied. Dr. Butler taught the bell Lab Composite Materials course and was the lab expert on glass carbon and aramid fiber interfaces with epoxy, polyester, metals and ceramics.

TECHNICAL EXPERTISE INCLUDES:

Business management to meet profit and revenue goals
 Technical management of large research groups and projects \$10 - \$15 million and 100 staff members
 Structural design, analysis, and fabrication of fiber/matrix composites
 Composite materials design, fabrication technology, and tooling expertise

PROFESSIONAL ACTIVITIES

American Ceramic Society (ACS), 1962 – present
 American Society of Metals (ASM), 1975 – present
 American Carbon Society (ACS), 1965 – 1977
 Keramos, Ceramic Engineering Honorary
 Alpha Sigma Mu, Metallurgical Honorary
 Society for the advancement of Materials and Process Engineering (SAMPE), 1978 – present
 American Solar Energy Society (ASES), 1975 – present, Chairman of Solar Thermal Division
 Solar Energy Industries Association 1984- Present, Board Chairman 1990-1994
 Solar Energy Industries Association, Concentrating Solar Power Division Chairman 1998-2002
 Member of SANDAG renewable energy working group 2005-present.
 Supporting the California Solar Initiative at the California Center For Sustainable Development 2006- Present

HONORS/AWARDS

American Men and women in Science
 Who's Who in America
 Materials Associate Editor, *ASME Journal of Solar Energy Engineering*, 1979 – 1981
 Fulbright Lectureship, Yugoslavia, 1983
 International Energy Agency, Solar Design Team for Alberia, Spain, 1978
 NASA Distinguished Service Award for Solid Rocket Motor Integrity Improvement.

PATENTS (9 Issued)

January 17, 1984	#4,425, 904	Tracking System for Solar Collector
April 16, 1985	#4,511,215	Lightweight Diaphragm Mirror Module System for Solar Collectors
December 24, 1985	#4, 559, 926	Centerless Drive Solar Collector System

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February 17, 1987	#4,643,168	Liquid Cooled Fiber Thermal Radiation Receiver
October 3, 1989	#4,870,949	Wind Resistant Two-Axis Tracker for Energy or Radiation Concentrators
May 10, 1991	#5,016,998	Focus Control System for Stretched Membrane Mirror Module
April 6, 1993	#5,199,499	Oil Well Fire Capper/Snuffer
April 24, 1995	#8,393,472	Long-life Self Renewing Solar Reflector Stack
January 4, 2005	#6,837,303 B2	Internal, Water Tank Solar Heat Exchanger

SECURITY CLEARANCE: DISCO/Secret/SAIC Terminated in 2002 on retirement from SAIC

PUBLICATIONS

Thomas Mancini, Peter Heller, Plus Barry Butler, Bruce Osborn, Wolfgang Schiel, Richard Diver, Vernon Goldberg, Reiner Buck, Charles Andraka, James Moreno, *Dish-Stirling Systems: An Overview of Development and Status*, Journal of Solar Energy Engineering, Copyright © 2003 by ASME MAY 2003, Vol. 125.

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Butler, B.L. and K.J. Beninga. *Design of a 100 MWH Sodium – Sulfur Battery Load – Leveling Facility*, May 21, 1987.

Butler, B.L. and K. Ramohalli. *Composite Membrane Dish Concentrators*, Solar Thermal Research Symposium, February 6, 1987.

Resume of DR. BARRY L. BUTLER, Page 5

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Butler, B.L. and M. Featherby. *Internally Metallized Ceramic Vacuum Pipe for Particle Beams*, 1987 Particle Accelerator Conference (CEBAF), February 27, 1987.

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CERTIFICATE OF SERVICE

I hereby certify that, pursuant to the Assigned Commissioner and Administrative Law Judge's Scoping Memo and Ruling, I have served a true copy of "Phase I Direct Testimony of Dr. Barry Butler" to all parties on the most recently updated service list for Application No. 06-08-010.

I declare under penalty of perjury under the laws of the State of California that the foregoing is true and correct.

Executed this 1st day of June, 2007, at San Francisco, California.



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