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Underground DC power line advantages

The issues of environmental, home and property damages are the central dilemmas that have been repeatedly brought up 1,000s of times by the people at CPUC hearings and in writing, along with medical risks and business losses; a portion of which would be caused by bulldozing many new roads to the proposed overhead 69 kV lines would add 110 new 100 foot tall steel structures to the nearly 700 huge steel pylons, 170 feet in height, carrying an array of hot sagging reinforced aluminum cables over our heads, homes, ranches and along our roads.

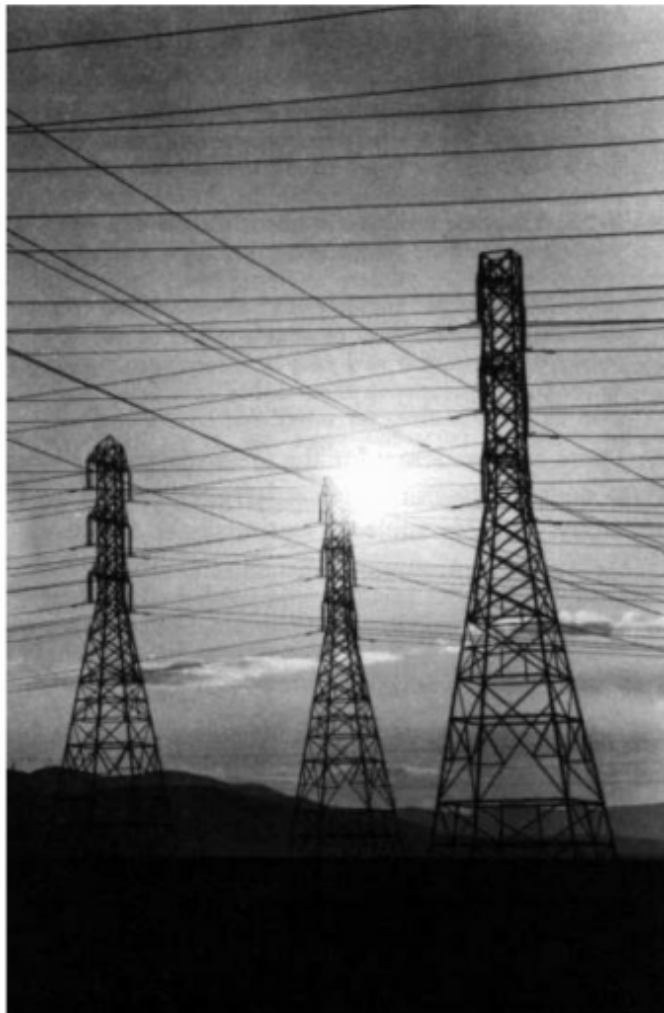
It has been made extraordinarily clear by the people of this region that nobody wants any of these damaging impacts here and have said so 1,000s of times, while requesting the

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same reasonable underground alternatives that had been more considerably offered along the Northern Route. Yet SDG&E, the CPUC, the BLM and Aspen have repeatedly ignored all their pleas and avoided any review of the benign requests that the people have repeatedly asked for, which incidentally is required by California law. The nondamaging requests have been dismissed as impractical or too costly. However a review of the current technical and economic information shows that those requests do not cost more, are immediately technically feasible and would protect all of the environment, the homes, property, businesses and the health of the people along the proposed power line routes. Consequently we are asking why this work was not provided.

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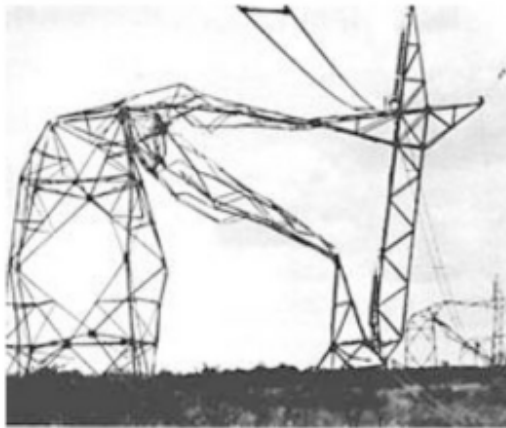
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Naturally, we find it curious that since the people are ultimately paying for the power lines, and they want to avoid extremely damaging overhead power lines and utilize some other alternative, then why does a public utility like SDG&E or the CPUC need to impose the more destructive technology on the people, particularly when it's evident that it's not in their interest and it's not their wish.

Please, before CPUC consultants again start providing old boilerplate excuses to oppose underground DC power lines which are not even true, which we have heard many times, and addressed those false criticisms in writing and at hearings many times, all without any consideration, consequently we have again listed these erroneous arguments and provided more contemporary information which is publicly available from the power industry, and from similar scale underground projects around the world and in the United States.



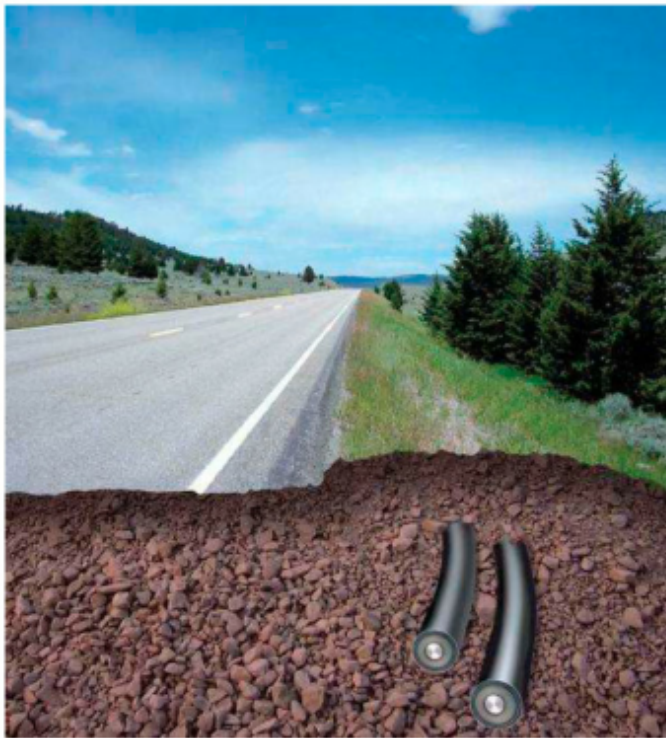
Fortunately, all the issues that the people have been repeatedly describing to the CPUC can be easily resolved, since underground power lines have been proven in over 50 large scale projects, and at a cost that is in total far less costly than the overhead AC power line that was proposed by SDG&E and perpetuated by the CPUC. We understand that major utility decisions cannot be based on misinformation or the avoidance of data, simply because

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it's more convenient for those assembling SDG&E or CPUC documentation to just reuse or update old data from prior projects, or from common data sources, which unfortunately to a large extent is what we are seeing. Nevertheless, the newer, nondamaging and the more appropriate technology is certainly available, and an introduction to that data along with technical references is also available here. The older overhead, pylon based overhead technology can be easily be proven to be extremely damaging to a large region, as well as higher in total cost, consequently completely obsolete for the SDG&E application proposed, and inadequate to address the California Environmental Quality Act Requirements (CEQA), while avoiding serious health and economic consequences to the people of San Diego County, who cannot afford well over \$20 billion in near-term damages, nor the long-term loss of thousands of lives. Further, the existing plans and review documentation provided by the CPUC and Aspen also avoid billions of dollars in savings that would be available to SDG&E, which could be a serious incentive to encourage Sempra Energy to consider less damaging technologies.

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Underground DC power line illustration, (not depicting full depth or protective concrete barrier).

The following table lists some of the advantages of underground DC technology that would apply to the SDG&E power lines, for any phase of the Sunrise Powerlink projects.

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Underground DC power line advantages being ignored

- 1 **Cost:** The total cost of underground DC is in total far less costly than the proposed 69 kv, 230 kv or 500 KV overhead AC technology. Continuously digging a 5 foot deep, 1 foot wide trench is far lower cost than building pylons. Installing underground cables along existing highways is also far lower in cost than overhead AC high power lines.
- 2 **Safety:** The serious matters of fire and aircraft safety, which has cost the people of San Diego County well over \$3 billion during 2007 alone, can be fully resolved through underground DC technology.
- 3 **Environmental damages:** The extremely significant matter of environmental damages, including over 9,000 acres of excavations, bulldozing and destruction to wilderness regions, plus 1,000's of acres of off-road extensions, can be completely eliminated through underground DC power lines.
- 4 **Reliability:** The matter of underground power line reliability is a great improvement compared to overhead AC power lines according to large-scale and long-term power industry studies; further underground cables are not subject to: storms, aircraft collisions, fire, vibrations, stress, corrosion, wind damages (which exceeded 110 miles per hour in many parts of Southern California during 2007).
- 5 **Capacity increase by 300 – 500%:** The issue of sufficient capacity is massively improved through underground DC technology. Currently over 8,000 megawatts are being scheduled for delivery from Imperial County and Mexico through San Diego County according to SDG&E. The Sunrise Powerlink proposes to deliver 1,000 megawatts, while far higher capacity underground DC cables can carry 3,000 to over 5,000 megawatts in just 2 cables buried only 5 feet deep in a small (approx. 1 foot wide trench) on just one side of a county highway, for a total of 10,000 megawatts on just 1 of 7 different county highways, with a long-term total of over 130,000 megawatts of capacity on existing San Diego routes, without causing or increasing any environmental or property damages.
- 6 **Property losses:** The issues of property damages, business and economic losses along the route can easily exceed \$20 billion on a short term basis, could be eliminated through underground power lines. Naturally, it is expected that the people will be forced to absorb all losses through eminent domain and aggressive litigation by SDG&E and through protective judicial reviews in behalf of SDG&E, which may or may not be true.

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- 7 Medical & cancer losses:** The matter of medical damages and losses of life as a result of electromagnetic fields and the ionization of pollutants, as an expected source of over 3,000 related cancer fatalities can be effectively eliminated through underground DC power lines. As molecular biology continues addressing the role of cellular microcurrents juries will be provided understandable arguments that can cost the power industry many billions for their continuing efforts to promote risks via overhead AC power transmission, while offering *plausible deniability* statements as a defense.
- 8 Viewshed losses:** Over 500,000 acres of viewshed losses, which degrade San Diego County's scenic highways, tourism resources and recreation resources, which state wide provide \$90 billion in income, can be completely avoided through underground DC technology.
- 9 Maintenance for pylons & overhead power lines:** Maintenance costs are far less for underground power lines, since overhead power line cables fatigue (lasting 30 or more years, depending on wind vibration fatigue requiring a more frequent replacement cycle), further steel pylons corrode (lasting 50 or more years, depending on humidity), all of which have to be replaced repeatedly, perhaps costing over \$4 billion on a 100 year basis.
- 10 Security costs:** Security costs for underground DC power lines, under county highways, would be low, as well as reliable and continuously monitored, while trying to protect 700 pylons in remote areas would be very difficult, costly, unreliable and easily catastrophic. Incidentally, this is why the Department of Homeland Security paid 60% of the cost to insure that high power lines to Manhattan were underground. Unfortunately, SDG&E didn't make such inquiries for assistance from Homeland Security, and wasn't familiar with the Homeland Security program nor underground DC projects in Europe or Australia. Naturally we would recommend including a TCP/IP fiber optic cable to make 1080p surveillance and automatic alarms available to local residents through the web, while providing rural communities with high speed internet access.
- 11 Electrical grid reliability:** DC interconnections between AC grids eliminates both phase synchronization requirements between distant cities, along with cascading blackouts that are inherent in large AC systems, where any single AC link can overload and trip, increasing the strain on neighboring links which in turn disconnect causing blackouts over vast areas, along with huge economic losses.
- 12 DC efficiency advantages:** The efficiency of DC transmission can reduce transmission losses by 50% compared to AC, as well as double the capacity at the same voltage, while utilizing only 2 cables (instead of 6) and providing for 500% greater capacity underground, all with significant long-term financial savings.

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A cooperative offer

There are billions of dollars in savings currently available that could be implemented by SDG&E, which we would be glad to assist with including the engineering and integration process, all with no salary, if SDG&E would donate 20% of the savings it makes to help protect habitat and threatened species, which constitutes a tax deductible contribution. This would naturally represent an 80% profit, on all improvements with no investment to address all the issues, and nothing to pay if it's not a guaranteed profit for SDG&E, plus a tax deduction of up to 20% to compensate for the 20% contribution. We of course have absolutely no idea why all of this effort isn't obvious, as well as completely beneficial for the people of San Diego County, including all the generation companies, as well as SDG&E's economics and naturally the environment, all with absolutely no damages or injustices needing to be perpetrated against anyone. Apparently, the public relations benefits could also be significant. Of course, we are not rash enough to believe that there would ever be any interest in mutual benefits, no matter what the rewards could be for Sempra Energy, which has long been the central dilemma of the business perspective and the state's economics; resulting in short term gain and long term tragedy. It's also what's extraordinarily disappointing to most Americans, that I would hope could be turned around for everyone's survival and benefit.

There is no inherent conflict between protecting the environment and installing high power lines. In 1881, Thomas Edison addressed the matter by placing the first power lines from the first power station completely underground. By 1883 high quality (kerite) insulated underground and underwater power cables were in production in at least three facilities. While high voltage AC transmission was introduced during 1893 in Redlands California, however it wasn't until 1950 that Shockley of Bell Labs designed the thyristor as a solid state device which could assist with rectification, converting AC to DC, and inversion converting DC to AC in high voltage applications. Beginning in 1965 the Los Angeles Department of Water and Power saw the benefits of this DC technology and ultimately implemented extremely reliable arrays of solid state thyristor power converters to connect power generation from the Columbia River on the Washington-Oregon border to Los Angeles, 846 miles (1362 km). The discoveries, innovations and risks have been successfully accomplished over the past 60 years. This underground DC technology is now mature, extraordinarily reliable and proven in over 50 major installations worldwide. We are not taking any risk by evaluating and implementing this technology. Further, SDG&E has already very successfully installed the same underground high power cables through San Diego, while the Los Angeles Department of Water and Power has over 40 years of experience, now with 3,100 megawatt DC transmission.

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Underground Cable Options

	Underground cable technology	Voltage DC, Amps	Capacity megawatts
1	Kerite, Permashield, 3.8" OD	138 kV, 1000 amps AC	138 MW
2	XLPE, cross-linked polyethylene, 6"	300 kV, 3066 amps DC	1840 MW (3000 sq mm)
3	PPL, Paper Polypropylene Laminate	600 kV, 3066 amps DC	3680 MW
4	SCFF, Self Contained Fluid Filled	800 kV, 3066 amps DC	4906 MW, oil insulated
5	GIL, Gas Insulated Transmission Lines Sulfur hexafluoride SF ₆ insulation	800 kV, 6400 amps AC or DC	10240 MW DC 5120 MW AC

Notes:

1. Kerite, claims to have shown zero electrical deterioration of its Permashield insulation formula after 50 years of continuous use and provides an unlimited warrantee, and have been manufacturing underground power lines since the early 1880's.
http://www.kerite.com/catalog/catalogfiles/high_voltage_138kv.htm
2. Where mountains are involved fluid filled systems would present serious pressure problems without an internal cellular structure.
3. Recommendations for XLPE, cross-linked polyethylene are to not exceed 345 kV, and preferably stay below 245 kV, to maintain a stable system without significant electrical deterioration. A review of all XLPE, cross-linked polyethylene, PPL, Paper Polypropylene Laminate, Kerite Permashield and related insulator formulations should be carefully studied and electrically tested based on old existing system examples, before selecting an insulation system.
4. Gas Insulated Transmission Lines (GIL) based on Sulfur hexafluoride SF₆ insulation and a high capacity cylindrical conductor can provide a very high degree of insulation, extremely high capacities and not sustain deterioration and could in one trench provide over 10,000 megawatts of capacity and should be carefully considered as a solution.

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Sulfur hexafluoride SF₆ with no free electrons creates a very efficient, fully contained and stable insulation system, that is 5 times denser than air, is used to assist with surgery and enhance medical imaging.



**Gas Insulated Power Lines
Direct burial and enclosed**

10,000 megawatts DC

5,000 megawatts AC


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10,000 Megawatt High capacity routes

- 1. Two existing ultra high capacity overhead routes**
- 2. Seven new high capacity underground routes**



200,000 megawatts of transmission capacity exist east and west across San Diego County without causing any environmental or property damages



I. Two existing high capacity 31,000 megawatt overhead routes to San Diego and Orange County

(Expandable to 30,000 MW of UHVDC east-west and 30,000 MW north-south + an integral 1,000 megawatt AC distribution corridor and no new environmental impacts.)

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Implementation of a 30,000 megawatt corridor from El Centro to San Diego can be incrementally developed using the existing 500 kV Southwest east-west right-of-way to San Diego, then continues north along the existing 230 kV right-of-ways to Orange County then to Lake Elsinore where it connects to Southern California Edison's (SCE) 500 kV corridor, all of which can be upgraded to 30,000 megawatts on pylons capable of carrying 3 sets of Ultra High Voltage Direct Current (UHVDC) cables, all based on a +/-800 kV upgrade using an updated version of the same proven DC technology used by the Los Angeles Department of Water and Power (LADWP) for 40 years.

This approach can provide for 2 separate access routes each up to 30,000 megawatts into San Diego, one east-west through Imperial County and one north to the SCE 500 kV AC grid, which is also capable of receiving or sending up to 30,000 megawatts, in order to provide 2 complete paths that can fully supply San Diego County. Phase one pylons could provide three 230 kV to 500 kV AC cables for local power distribution with 2 additional cable pairs above for UHVDC, with adequate pylon strength and space to add 2 additional cable sets at a later date with 10,000 megawatts each, for an ultimate capacity of 30,000 megawatts. Which can mean bringing up to 60,000 megawatts into San Diego or sending up to 30,000 megawatts north into the SCE grid, all without increasing SDGE's environmental footprint, all of which can also provide for 2 separate high capacity paths from Imperial County's renewable resources to San Diego.

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Ultra high capacity route, from El Centro to San Diego to Orange County

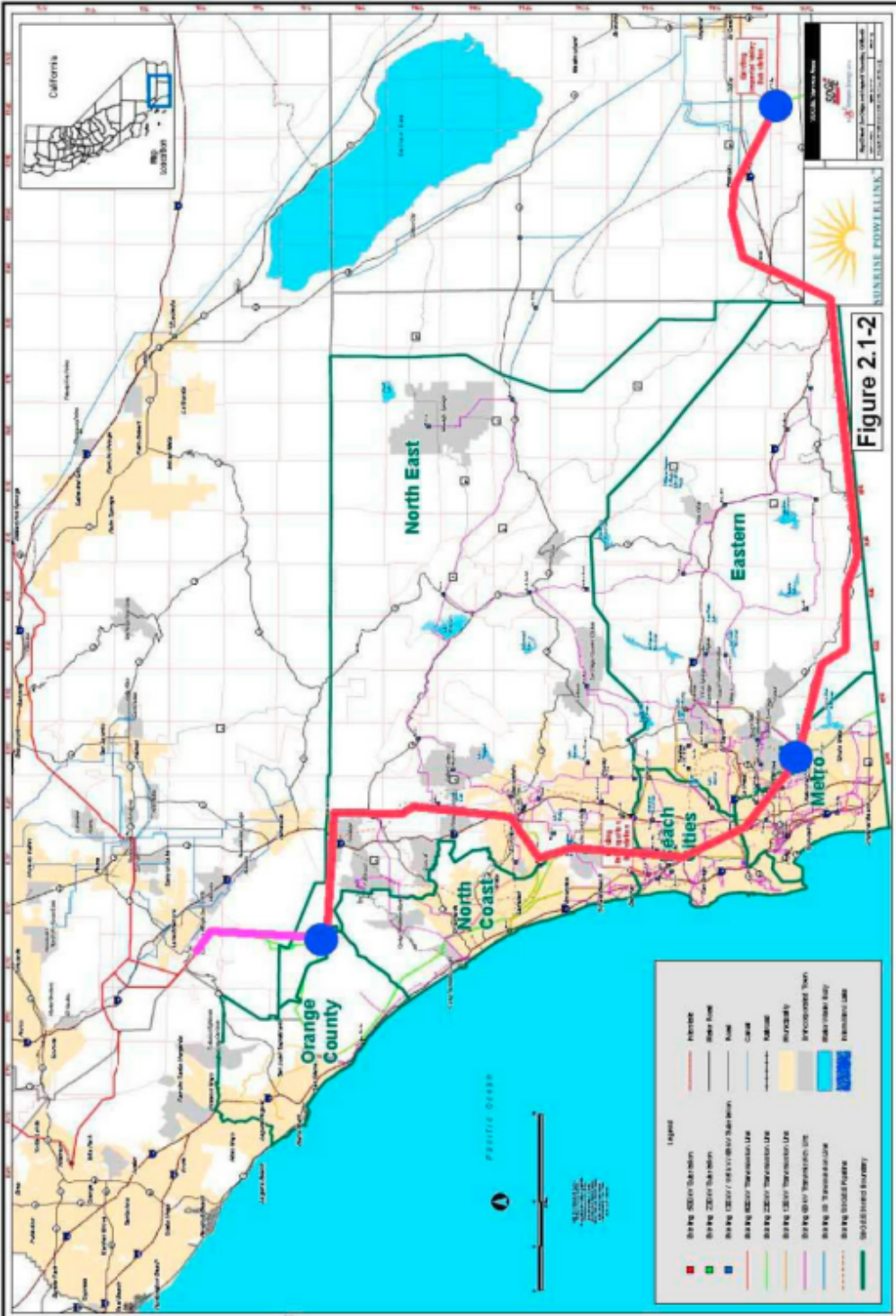


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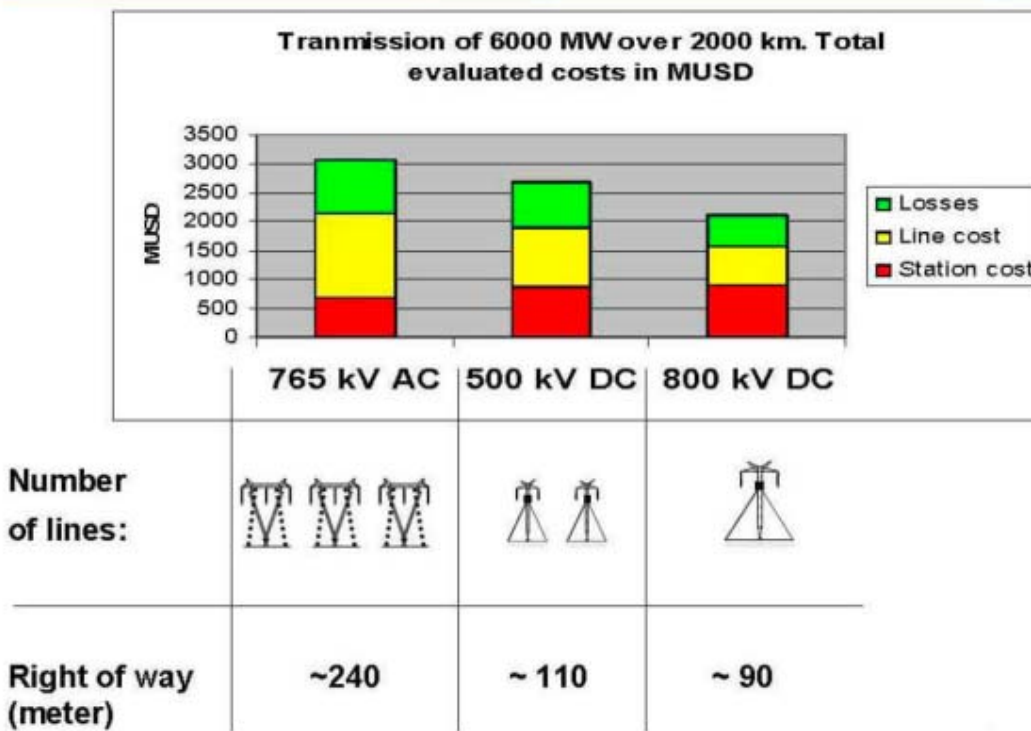
Pacific Intertie 3,100 megawatts, +/-500 kV DC, 1965 LADWP

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Transmission Economics



The proposed 1,000 megawatt Sunrise Powerlink does not provide significant future expandability to even begin addressing San Diego's transportation needs, nor is it able to deliver more than a small fraction of the 7,000 megawatts that SDGE indicates it already needs to deliver from renewable generators in Imperial County to San Diego. Consequently, many more Sunrise Powerlinks would be needed, resulting in extraordinary economic and environmental damages and far higher costs to SDGE, unless a more comprehensive solution is considered.

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Advantages of +/- 800 kV Ultra High Voltage DC transmission including an AC distribution line

1. The first advantage is that no new transmission corridor has to be created.
2. Existing right-of-ways are used to implement a system with over 30 times the existing capacity.
3. Capacity is expandable in 1,000 to 10,000 megawatt increments on same pylon system, by either upgrading the converter stations or alternatively adding another set of cables.
4. No new environmental or property damages are imposed on the region.
5. The expansion of renewable power at remote locations across both San Diego and Imperial Counties is provided for with an integral 1,000 megawatt AC power line, in addition to addressed San Diego's future needs for many decades with 30 times the capacity of the Sunrise Powerlink.
6. Coverage areas include Southern Imperial County, San Diego, Southern and Western San Diego County, Orange and Southwest Riverside County, with a 500 kV link to Southern California Edison's 500 kV AC line near Lake Elsinore.
7. This power corridor functions both as a super high capacity point to point DC network and as a 500 or 230 kV AC distribution network to provide coverage for county wide distribution and recovery of widely distributed wind and solar generation facilities in San Diego County.
8. Such a high capacity hybrid delivery system could be capable of feeding 30,000 megawatts into Orange, Riverside and Los Angeles Counties based on electrical demands from southern Imperial County, or points eastward in Arizona or south in Mexico (which could change with LNG).

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9. As global petroleum resources are consumed, at least 20,000 additional megawatts of power will be needed for San Diego County's vehicles in the short term, which can easily double, perhaps ultimately requiring 60 megawatts of capacity. Designing a system that can be upgraded to 30,000 megawatts of new capacity is a conservative increment that should be increased, based on the route's actual overhead capabilities, which could alternatively include at least 60 megawatts of underground cables in 6 separate 2 foot wide trenches, 5 feet deep, each 10 feet apart, as described later, which incidentally could render even this high capacity overhead route obsolete, in deference to a completely underground 60 megawatt system under the existing Southwest 500 kV AC power lines already in place, which could allow the existing 500 kV lines to revert to local distribution uses for San Diego and Imperial County, with increments of up to 60 megawatts to reach San Diego, Orange and Los Angeles Counties, all underground within existing right-of-ways in use.
10. No new overhead AC power lines need to be implemented except for small scale local household distribution, which could be underground. Future EMF cancer risks can be reduced through DC and by undergrounding all local AC power lines.
11. While power generation represents only 20% of anyone's electric bill, most people undoubtedly will not want to pay ½ cent per kilowatt hour by installing photovoltaic panels on their roof, nor have they been educated to understand the issues, so they will probably remain dependant on SDGE, SCE and the LADWP for a very long time, unless of course installation companies can economically and reliably address installation.
12. The primary issue remaining is how to stop economic and environmental damages, or how to stop either faction from violating California and federal laws, or alternatively how to get SDGE to addressing paying an estimated 6 to 20 billion dollars in short term damages, plus vastly more in medium term damages, if it builds the grossly inadequate 1,000 megawatt Sunrise Powerlink.
13. SDGE now indicates that there are at least 7,000 megawatts of renewable power resources being scheduled for delivery on the 1,000 megawatt Powerlink, so SDGE

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already knows that they will need well over 10 times the capacity of the Sunrise Powerlink to deliver just the first phase of that supply. So what plan could SDGE possibly have to resolve this future load problem, 20 to 40 additional Sunrise Powerlinks (numbered 1 through 40)?

14. If SDGE needs well over 10,000 megawatts of additional capacity from Imperial County into San Diego and Orange and Riverside Counties then where do these new 10 to 40 additional Powerlinks go, all over San Diego County, until the EMF is so intense that everybody gets Leukemia and lung cancer as their birthright?
15. China is already building or planning over 20 such high capacity UHVDC power lines that will minimize environmental impacts and lower the cost of building high power lines. But Southern California with the highest energy demands is incapable of considering a safer, higher capacity system that doesn't increase any environmental impacts?
16. The cost per 1,000 megawatts of capacity with UHVDC is considerably less as well as more efficient than conventional 500 kV AC power lines.
17. The environmental and economic savings to the region achieved by using UHVDC would be over 20 billion dollars in short term damages and far more in medium term damages per 500 kV AC power line, and apparently many times that amount as additional power lines are needed. The Sunrise Powerlink's AC strategy is a flawed vision.
18. The low capacity, high impact Sunrise Powerlink is the most costly approach and perhaps the most damaging strategy that could have been devised. Both underground DC and an upgradeable approach to UHVDC using existing right-of-ways can save many billions of dollars both for SDGE and for the people of the region.
19. With 2 high capacity power line routes serving San Diego, with 10,000 to 60,000 megawatts each, expandable say in 1,000 megawatt increments, either one could be shut down for maintenance or to improve capacity.

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20. A 2 level, wide profile, pylon could accommodate one +/-800 kV pair of DC lines on the first level to transmit 10,000 megawatts plus three 500 kV 1,000 megawatt AC cables, and as future expansion was required a second level could be added to carry two additional 10,000 megawatt DC circuits. Insulators can be arranged in a typical "V" pattern, with reduced pylon to pylon spacing and minimize cable motion in high winds, as well as maintaining a safe compact design to minimize visual intrusion, with less cable sagging, less stress, lower cable fatigue and lower maintenance costs.
21. A fiber optic link can provide for high definition video security cameras on each pylon to provide for security monitoring, also directly available to law enforcement and the public, along with free wide area high-speed internet to all residents along the power line route, with an ability to rotate and zoom a camera on each pylon, when not being used by SDGE or law enforcement.
22. SDGE could provide a web site which contains isoline maps showing EMF levels from the 1 milligauss level, up to the power lines, with signs on each side of the pylons showing the 2 milligauss (mG) level locations, particularly between pylons, so that residents can consider their health safety, as well as protect their home and property values.
23. A mixed AC and DC power line could provide one or more high capacity, high efficiency DC transmission systems, along with a 1,000 megawatt AC path to pick-up and distribute scattered wind and solar generation resources along the route.
24. This mixed ultra high capacity AC and DC transmission system may well address San Diego, Orange and western Riverside County's needs and support the needs of the state grid well into the next century, all without creating any new routes, nor increasing any damages to the environment, or increasing harm to property interests.
25. With a more efficient grid that could save SDGE over \$20 billion in construction costs over several decades, as well as saving 100's of thousands of acres from environmental devastation, and saving many billions in property losses and liabilities, there's no doubt that SDGE could afford to reimburse everyone for the full

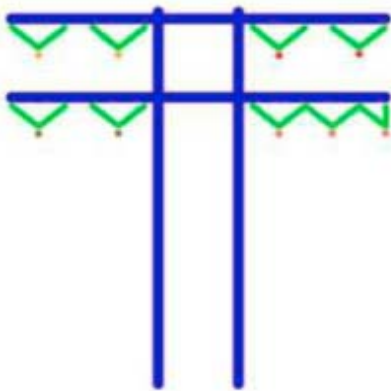
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replacement value of the property they lost or which was damaged along existing high power lines. Instead of the power industry spending 100's of millions of dollars trying to deny EMF and pollutant ionization associations with cancer, funding could be provided for a molecular biology institute to assist in reversing electrical field promoted cancers, including leukemia and lung cancer.

26. Restoration of environmental damages caused along existing power line routes can continue by researching drought tolerant on-site propagation techniques based on rainfall, nutrients, moisture retention, genetic strains and improvements to benefit drought tolerance.
27. The public relations benefits for protecting the environment on a massive scale, while addressing the molecular biology of ion and field promoted cancers, eliminating any significant need for eminent domain, supporting sustainable electrical generation and resolving the huge electrical demand for plug-in hybrid vehicles, could incidentally result in large scale, as well as profitable benefits for Sempra Energy, along with supporting the governor's administration.



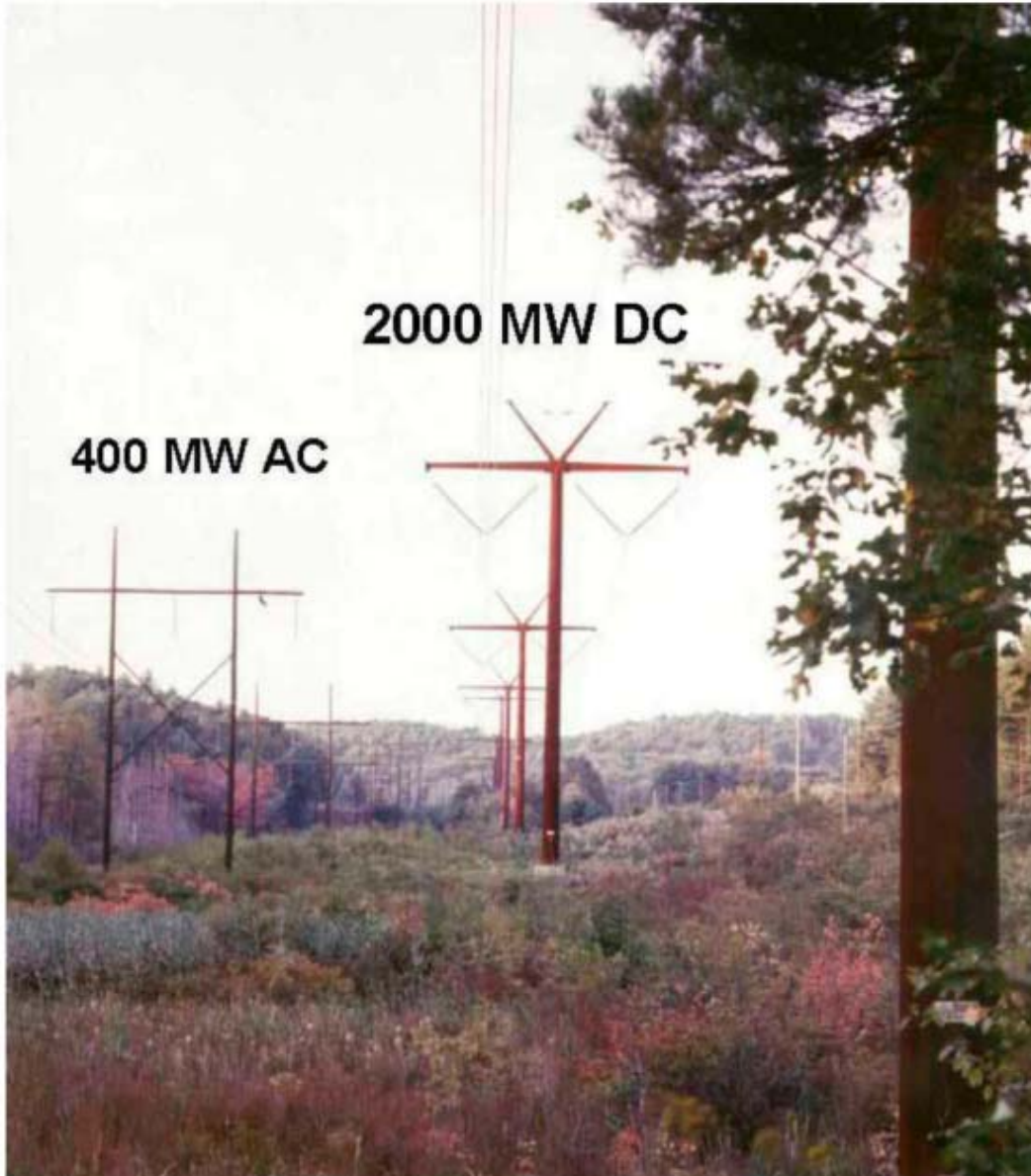
High capacity 31,000 megawatt pylon diagram for: three 10,000 megawatt DC lines and one 1,000 megawatt AC circuit, (with all + and - cables on opposite sides).

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The lower impact steel pylon to the right carries 2,000 megawatts, twice the capacity of the Sunrise Powerlink