Demand side water management in Los Angeles and San Diego : in search of sustainable water supply

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ABSTRACT : Los Angeles and San Diego have always been challenged by water resource scarcity. They have dealt with this problem by adding imported water to their local resources. They purchase imported water from the Metropolitan Water District of Southern California, which owns and operates the Colorado River Aquaduct and is entitled to control half the water the State of California routes from the north to the south through the California aquaduct. Since the worst drought that ever occured in California (1987-1992), Los Angeles and San Diego Water Departments have worked on reducing water demand. Demand side management has become a strategic dimension of their water supplies.

1 INTRODUCTION

From 1987 to 1992, California faced the worst drought of its history. The usual 5 months of rainfall that supply 35 million person water demand had been insufficient for 5 consecutive years. The result of which ended up in water restrictions in direct proportion to each major city's dependance on imported water.
California rainfalls are both geographically and timely inequal. They occur north of the Sacramento River where semi-desertic southern California holds a third of the water consumed by its 17 millions inhabitants. Only 10% of the water used by the cities of Los Angeles and San Diego has local origin. The remainder comes through long distance conveyed water, or the « California way » of supplying water. Since the beginning of the twentieth century, the distance and the volume of routed water have deeply increased, making it possible to sustain the fastest demographic growth in the USA.

Los Angeles and San Diego have developped different water supply strategies in respect to their demographic profiles.

Los Angeles built up the first aquaduct in California in 1913 (385 km, 200 millions m^3 capacity) for its own usage. Then the Colorado River Aquaduct (390 km, 1.5 billion m^3capacity), built and run by Metropolitan (the Metropolitan Water District of Southern California) since 1941, introduced regional water systems to Southern California. Metropolitan knew its system would become insufficient as early as the late fifties. Water transfers were planned on a huge scale by the State of California to meet ultimate statewide needs. The Northern abundant and unused resources would have to offset current and coming water deficits, in particular in Southern California. In 1961, the DWR (Department of Water Resources) committed to sell 50% of the 5 billions m^3 of water it would convey every year through the State Water Project, down to Metropolitan territory, 1000 km away, from 1971. A year earlier, Los Angeles completed its second aquaduct, as big as the first one, in order to limit up to 5% its dependancy on Metropolitan imported water.

Conversely, 95% of San Diego water demand depends on the water wholesaled by the city from Metropolitan through SDCWA (the San Diego County Water Authority). In 1940, San Diego's population was equal to the population of Los Angeles in 1910. During the 1940s though, due to its strategic position during the Second World War, San Diego's population increased by two-third,

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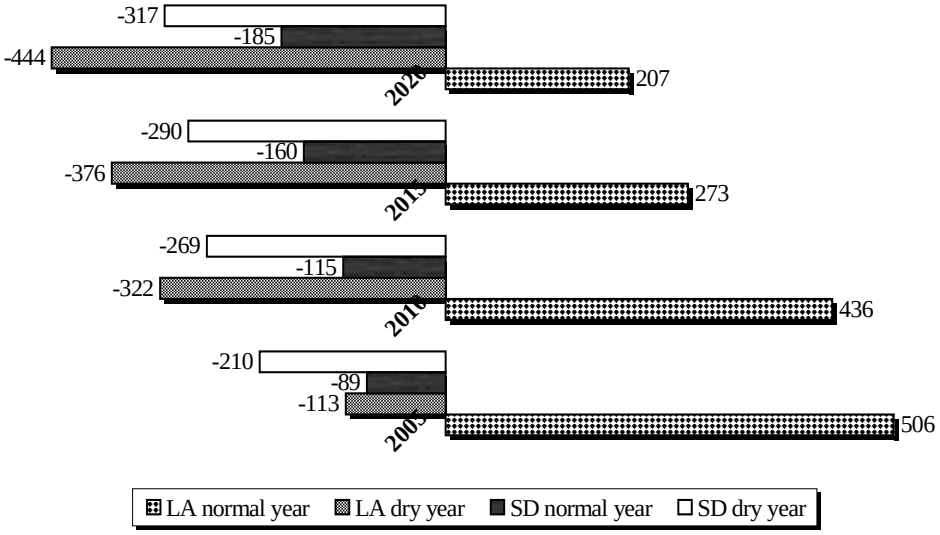
leading to the need for imported water. San Diego became a Metropolitan client in 1946. Along with SDCWA, it has become Metropolitan's largest purchaser.

The 1987-1992 drought has led to a major change regarding the way Los Angeles and San Diego among others cities would have to consider future water supply. Increased water transfers to comply with never-ended increased demand are no longer feasible. This one-century solution was designed to meet agricultural, industrial and urban needs but did not take into account the environmental damages endured by export areas. Today, environmental protection comes first and transfered water users must deal with it by reducing their dependancy on imported resources.

New limits were set up between 1997 and 2001. They help to figure out the water deficits that Los Angeles and San Diego would incure by 2020 if they do not work on reducing water demands and on developping new water supply (Figure 1).

Figure 1. Los Angeles & San Diego water deficits from 2005 to 2020 (millions m^3)



The 1987-1992 drought has also found expression in increased cost of transfered water. With given fixed costs, a reduced volume of transported resources rises the water unit cost. During the drought, when Los Angeles Aquaducts capacity was as reduced as it will be in the next 20 years, the unit cost rised from \$0.08/ m^3 to \$0.4/ m^3. In the same time, the water routed by the DWR was as limited as the level that has been set up until 2020 and its cost doubled, from \$0.12/ m^3 to \$0.24/ m^3. Imported water has lost its position as cheapest water supply. Los Angeles and San Diego started to redesign water supply strategies according to the cost profiles of alternative resources and their reliability in case of drought.

Last, the 1987-1992 drought has brought to light a major conflict between Los Angeles and SDCWA, regarding the way Metropolitan water is allocated amongst its 26 members. Los Angeles, as the founder member, supports the in force allocation regime, based on each member's historical contribution to Metropolitan tax income, which provides Los Angeles with 23% of Metropolitan water. SDCWA, as the first Metropolitan customer, seeks to bring into operation an allocation regime based on each member's historical contribution to Metropolitan tax and watersales incomes. This new regime would double the SDCWA entitled volume, and hence San Diego imported water supply, but reduce by two third the volume Los Angeles gets with the preferential rights regime.

Both Los Angeles and San Diego work simultanously in three directions in order to meet increasing population water demand : water demand reduction, reallocation of the water wholesaled by Metropolitan and development of cost-effective water.

2 WATER DEMAND REDUCTION

If Southern California water demand was as low as in Europe (180 liters/capita/day), Metropolitan would be able to supply enough water until 2020, even during dry years, and regardless of the local water available within its 26 members' territories.

Los Angeles and San Diego water demands, respectively 580 l/c/d and 640 l/c/d, raised by 6% and 8% in dry years, can be partly explained by outdoor uses which make these cities almost look like tropical places despite their semi-desertic climates. In Southern California, the water consumption levels are a paradoxal consequence of the climate that anywhere else would conversely lead to a careful use of the water resource. The indoor consumption is as high as US average water demand and can grow up over 1 m3/c/d in single-unit because of outdoor use.

In other words, the forecasted water shortage in Southern California is firstly the result of high water demand even though the long-distance water drop hastens it.

The demand-side management aims at reducing water consumption per capita in order to release enough resources to meet demand induced from the demographical growth. Urban water services provide their customers financial incentives to set up conservative domestic equipment such as ultra-low-flush toilets and high-efficiency washing machines. They also increase water rates to promote conservative behaviours.

These policies have already given strong results, as shown in table 1.

Table 1. Annualy conserved water in 2000 (millions m3)

	Los Angeles	San Diego	Metropolitan
Conserved water	161	31.2	817
Conserved water due to new domestic equipment	52.4	21.4	557.7
Conserved water due to rate increase	108.6	9.8	259.3

In Los Angeles, water demand in 2000 was similar to that of 1985, despite a population growth of 600,000 people. This spectacular result comes from the very voluntarist politics led by the LADWP (Los Angeles Department of Water and Power) which invested $100 millions over 10 years, of which 75% was spent on the fittings of 950,000 ultra-flosh toilets, responsible for 90% of the water conserved in this category. But the consumption decrease (60 l/c/d) has been mainly attributable to the progressive rate structure applied since 1995.

Its main characteristics are :

- No base fee
- A low rate ($ 0.3999/ m^3) is applied to basic uses. For superior demand higher rates depend on the season (winter, summer), the type of house (multi or single unit), and the zone of residence (3 different micro climates)
- Basic uses are quantified according to the house surface area (the bigger the higher, on a scale from 1 to 3), and to the average temperature of the zone one lives (20% difference). Basic uses are also bigger in summer
- In single unit, incremental demand is charged double during winter (November 1rst to May 1rst). In summertime, incremental demand is charged 2,5 times more ($ 1.0524/m^3) to all type of units

The very progressive rate structure of Los Angeles translates a discontinuous operating costs structure, according to the type of water supplied in 1995. In raising order, the Los Angeles Aquaducts water comes first, which costs $0.08/m3 when operated at full. Next are local resources, $0.12/ m^3 that meet from 5 to 10% of demand. The remainder is supplied through wholesales from Metropolitan, $0.28/$m^3$. The progressive rate structure aims at limiting wholesales water: a 10% variation in demand makes the full supply cost of Los Angeles three times bigger and increases its operating costs by 15%.

In San Diego, the water supply incremental and average costs are the same as long as 95% is wholesaled from Metropolitan through SDCWA, which adds to Metropolitan rate ($0.28/$m^3$) its transportation cost, $0.07/$m^3$. Therefore a progressive rate structure aims first at easing the pressure on

SDCWA whose wholesales from Metropolitan exceed far more the volume of water secured by its preferential rights. However as far as the water supply cost is continuous and represents half the operating costs of the San Diego Department of Water, a very progressive rate structure with a base rate below the average supply cost may quickly turn out in an operating deficit. Indeed, a 10% decrease in demand leads only to a 5% decrease in the operating costs.

Therefore, the rate structure voted in San Diego in 1999 is not as an incentive conservative as in Los Angeles. Restricted to single units, the San Diego Department of Water rate structure has a base fee and distinguishes three different rates : the first 20 m3 are 10% more expensive than in Los Angeles but the highest rate is 40% below the highest LADWP rate. Since July 1st 2002, the San Diego Department of Water rate structure has been made less progressive : the base fee has increased by 11%, up to $10.68 monthly, and each rate by 4%. A big consumer bill (over 1 m3/day) is 5% more expensive whereas a small consumer bill (below 9m3/month) has raised by 8%.

By increasing its fixed income, the San Diego Department of Water is protecting itself against the impact of decreasing demand on its budget balance which was in deficit in 1999. By doing so, the San Diego Department of Water has decided to manage without the conserved water that is anyway considered not to be sufficient to offset the forecasted water supply deficit.

Table 2. Annual water conservation goals by 2020

	Los Angeles	San Diego
Conservation due to new domestic equipment	55.4 millions m^3	19.7 millions m^3
Equivalent in number of people supplied	330,000	90,500
Water demand in 2020	560 l/c/d	610 l/c/d

For the next 20 years, the goals assigned by the LADWP and the San Diego Department of Water regarding conservation are equivalent to those achieved in the last 10 years (Table 2.).

The conserved water will make it possible to supply up to 30% of the Los Angeles and San Diego demographic growths. None of the two urban water services took into account in 2000 the impact of the water rate elasticity of demand. Though, the demand level targeted gives room to further conservation. At the level of its territory, Metropolitan forecasts that 36% of the 441 millions m3 conserved from 2000 to 2020 would be due to rate increases. San Diego has already raised its rates and set up equivalent annual raises until 2007. Conversely Los Angeles has not yet adjusted its rate structure to the supply cost structure that comes with its new water supply composition, mostly made up with the most expensive water wholesaled from Metropolitan. Nevertheless, the LADWP water supply average cost is from now higher than its former incremental cost (Figure 2).

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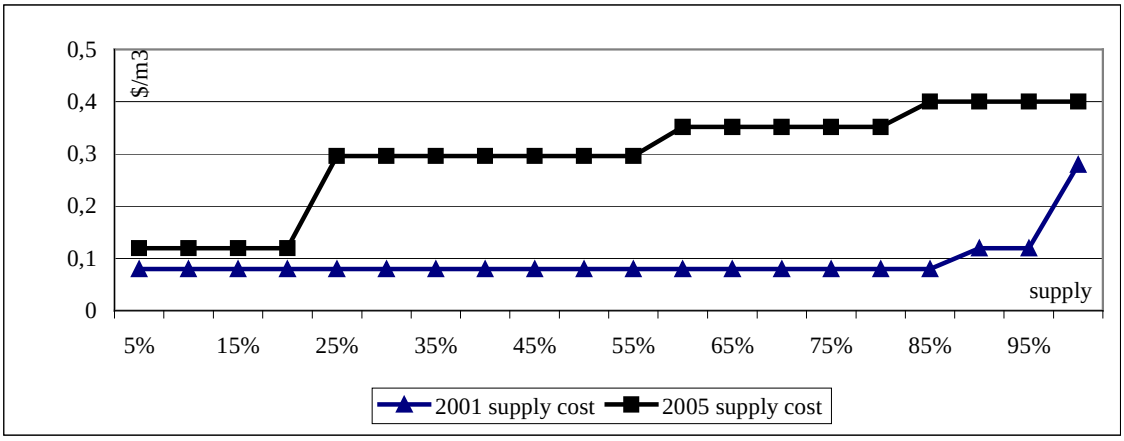
Figure 2. LADWP supply cost structure in 2001 and in 2005



Both wholesaled water from Metropolitan and new supply water that the two cities are about to develop will be more expensive. This means that water rates are going to increase soon since both

urban water departments pass on the cost of water supply to the drinking water rate. This also means that the volume of conserved water is likely to be more important than forecasted.

One can consider that Los Angeles and San Diego water rates are so low that both water departments may increase their rates to push their consumers to moderate their consumption. One may even think that the low water rates levels bring about the high demand level.

But beyond rate levels, it is interesting to notice that Los Angeles and San Diego water bills are higher than same sized French services bills. A San Diego consumer already pays $384 per year, an average bill that exceeds the affordability index of $328/year working out by the US Environmental Protection Agency for a Californian family. Assuming that water consumers are more sensitive to bill level than to rate level, the main questions are : are they able to behave in a much more conservative way as quickly as required by the water supply restrictions, in order to keep their bills to the same level ? If not, how would they react to big rate increases ?

These questions deal with the social and equity side of sustainable development. Even though conservation is the cheapest way to increase water supply ($0.12/$m^3$), it requires to raise rates to be efficient.

3 REALLOCATION OF METROPOLITAN RESOURCES

Metropolitan rate policy substantially changed in 2002. Forecasted supply drop is going to double its water supply cost ($0.32/$m^3$ in 2010 versus $0.18/$m^3$ in 1995), since Metropolitan has to absorb the same fixed costs with a volume of resource 40% lower than expected.

In order to balance a budget whose 90% expenses is fixed and 80% income is variable, Metropolitan has to increase its rates, thus to reduce the competitive advantage of its water. To get sufficient incomes, Metropolitan has set up new rates since January 1st 2003 (Table 3.). Its members may take advantage of a lower rate (rate 1) applied to 90% of their highest historical purchases if they commit to buy at least 60% of their highest historical volumes until 2018. A higher rate (rate 2) is charged to their additionnal purchases. The members who do not commit for 15 years would see their purchases charged on rate 2 basis, as soon as their purchases exceed 60% of their historical highest volumes. However, Metropolitan stopped subsidizing local resources development, in order to provide its members with a price signal, according to which each of them has to set up a competitive water supply strategy.

Table 3. Metropolitan rate structure ($/$m^3$)

	1995-2002	2003	2004	2005	2006	2007	
Raw water	0.2829	0.2643	0.2821	0.2959	0.2975	0.3016	Rate 1
		0.33	0.3381	0.3518	0.3535	0.3575	Rate 2
Treated water	0.3494	0.3308	0.3567	0.3624	0.3964	0.4232	Rate 1
		0.3964	0.4126	0.4426	0.4426	0.4791	Rate 2

Metropolitan's members commitment to buy 60% of their highest historical volumes is equivalent to Metropolitan commitment to supply those volumes even during dry years. In this case, Los Angeles commitment would be worth a volume, 305 millions m^3, pretty close to the volume secured by its preferential rights. SDCWA commitment would be worth 495 millions m3, much more than the 220 millions m^3 secured by the preferential rights regime. The new water allocation regime appears like the most clever way Metropolitan has choosen to solve the conflict between Los Angeles and San Diego regarding the former regime. In case of drought, Los Angeles would get the same volume of water in either regime and SDCWA a volume as high as the volume that would come out of the reform it has been claiming for. SDCWA understood it very well: it had never wholesaled so much water from Metropolitan as in 2002, in order to boost its historical volume of reference.

The new Metropolitan rate policy outlines the increasing water supply cost that its members will have to face. Under the best conditions, Los Angeles and San Diego will pay in 2007 their purchases 10% more than in 2002.

Last, this progressive and incentive rate policy shows that Metropolitan's mission to offset Southern California water deficit is over. It is now in charge of providing its members with basic supplies and lets them to be responsible for building up their remaining supplies. In case of drought, neither Los Angeles nor San Diego would be able to meet water demand with Metropolitan water. Consequently, both have to find out cost effective additionnal supplies whose levels will help them to figure out their commitment to Metropolitan.

Like many urban water services in California, Los Angeles and San Diego have seen the water market as a promising way to be provided with the additional resources that Metropolitan is no longer able to supply.

The water market was born in 1991 when the State of California created the Drought Water Bank in order to moderate the restrictions that cities were putting up with the drought. The Drought Water Bank is in charge of organizing transfers between the DWR partners. Agricultural districts sell part of their annual entitlements to urban services through an auction based mechanism sponsored by the Drought Water Bank. Water sellers get the income relative to the volume they give up and water purchasers pay in addition to this price the incremental transportation cost that the DWR charge them.

These one year transfers make up the spot water market. Longer term contracts are so far suspended from water rights modifications.

A first step was completed in 1995. The rights were equalized amongst the DWR partners. The former regime gave a priority to urban services, in case of drought, at the expense of agricultural districts. The 1995 Monterey Agreements stated that available resources would be allocated in direct proportions to contractual volumes, regardless of their use. Potential transfers would thus become predictable. Urban services gave up their priority as a compensation for a lower global agricultural entitlement. This means that the water right of use hold by the State of California since 1959 has to be modified to comply with the new volume that each partner would be entitled to buy.

A water right of use is modified as it is created, according to the terms of the EIR (Environmental Impact Report), conducted by the SWRCB (State Water Resources Control Board). The concerned use must be useful and reasonable. Urban water supply has always been considered as both useful and reasonable. The concerned use must also not reduce prior water uses which used to be agricultural districts, urban services and industrial companies.

Since the 1970 California Environmental Quality Act, the environmental use has become as useful and reasonable as traditional uses. No permit can be delivered should the concerned water be likely to spoil the environment. In such case, the potential water user is asked to pay for the environmental damages his use may produce, in order to let the environment as it was before. These considerations have raised the cost of water permit and the time required to get an answer from the SWRCB up to 10 years. Actually any environmental protection association is able to represent environment interets to the SWRCB. As many associations are opposed to the DWR water transfers, many have challenged the EIR on which the Monterey Agreements enforcement depends. They call the attention of the SWRCB on to unoticed injuries in order to raise the negative impacts up to a point where water transfers would no longer be cost effective.

Water transfers from the Colorado River are symptomatic of the raising water permit cost. In 1998, SDCWA and IID (Imperial Irrigation District) came to a 45 to 75 years agreement to exchange 247 millions m^3 per year. Last december, the temporary EIR results stated that this exchange would dangerously increase the salt content of the Salton Sea which harbors endangered species. The injuries would need $1 billion work to be corrected. SDCWA and IID have already reconsidered their exchange down to 98,7 millions m^3 for 5 years.

The worst is that once settled, long term transfers are neither pricely nor timely secured. Since the Public Trust doctrine has been qualified as being relevant to fix the water right litigations in 1983, not only requested water permits but also the in force ones are subjected to environmental rules. According to the environment regulation the Federal State keeps on developping, water permits may be either reduce or cancel to comply with new regulations, or suspended from expansive repair works.

Los Angeles has been the first urban service to deal with such a court decision. The city was condemned to half reduce its aquaduct water supply and has to fund dozens of millions of dollars to repair the unjuries.

The increasingly competing water usages have so far led to substantial price raises on the water market (Table 4.).

Table 4. Water market rates ($/m^3)

	Water rates	Transportation cost to Metropolitan	Water market rate for LA	Transportation cost to SD	Water market rate for SD
1991	0.1013	0.04	0.1043	0.0446	0.1859
2001	0.18	0.04	0.22	0.073	0.2924
2003	0.2027*	0.073	0.2757**	0.073	0.3487

* SDCWA-IID rate agrement without the EIR impact

** virtual rate that LA would pay according to SDCWA-IID rate agreement and the transportation cost charged by Metropolitan

Between 1991 and 2001, the water marketed by the DWR had increased up to 80% : it costs more before being routed than it would cost to Metropolitan if it gets its contractal amount ($0.12/m^3) from the DWR. The content is worth more than the technical system of transportation. In other words, the market water that flows to Los Angeles and San Diego and which is only charged with the incremental transportation cost is as costly as the water wholesaled by Metropolitan from the DWR and which is charged at full transportation cost.

Recent court decisions have brought into light the cost that urban services would have to face for their uses to be environmentally respectful. The way this cost is directly charged to the involved users fits into a dynamic that makes sense to sustainable development. Since urban water services have to deal with high demographic growth, and increase their water supplies in a cost-effective way, this dynamic leads them to think their development under environmental protection constraints.

4 THE DEVELOPMENT OF COST-EFFECTIVE WATER

The alternative options are recycled water and desalination ocean water.

Recycled water has been experimented for many years in Southern California. In 2000, Los Angeles and San Diego planned to speed up this type of local water supply (Table 5).

Table 5. Recycled water goals by 2020 (millions m^3/year)

	Los Angeles	San Diego	Metropolitan
Recycled water in 2000	51.5	4	333.2
Additional recycled water by 2020	74.75	20.3	222.1
Equivalent in number of people supplied	368,700	92,000	838,000

These levels of production would allow Los Angeles and San Diego to lower their deficits in case of drought to respectively 313 and 277 millions m^3 by 2020.

Recycled water is not used for drinking purpose. But the resources that used to be consumed for irrigation and some industrial purposes become available for others consumers. Thus, recycled water provides both cities with reliable additionnal resources since recycling is not dependant on climate conditions.

On the other hand, Los Angeles and San Diego will not keep on recycling water under the financial conditions they expected in 2000. From 1995 to 2002 Metropolitan refunded its members the difference between recycling cost and its treated water rate ($0.35/m^3) capped to $0.2027/m^3. Since January 1st 2003, local water services must face the full cost of this kind of supply that ranks from $0.259 to $0.678/m^3.

At the same time, desalination technique has become more cost-effective water supply. In 2000, desalination was still too expensive (from \$1.0539 to \$1.7835/m^3). But since the Tampa Bay water department (Florida) has set up a desalination plant and is provided with drinking water that costs \$0.608/m^3, it has become clear that desalination would interest Southern Californian urban services. This technique combines many advantages :

- This process increases the amount of available resources, conversely to the water market that only aims at reallocating resources, and raises for this reason political issue regarding agricultural activity. California produces 60% of the US fruits and vegetables and finds it difficult to let its producers give up their activity in order to rely on the watersales incomes
- Desalination produces drinking water, conversely to recycled water. More precisely, recycled water may be drinkable, but is still unfavourably considered by the population. Los Angeles was about to start distributing such a water to its consumers but had to abandon this project during the municipal elections, under a media denunciation campaign whose slogan was « From the toilet to the tap ! »
- Desalination is providing a water supply security that is lacking to long distance routed water. Desalinated water does not depend on neither climate hazards nor surface water regulations
- Desalination process is as competitive as recycling
- Desalination is becoming as competitive as water marketed regarding the increasing cost of the water resource and its treatment. In 1985, water treatment was worth 12.5% of the treated water that Metropolitan wholesaled. In 2001, it was worth 20% and had to increase up to 22% by 2010. In fact, this increase would be achieved as soon as 2007. The treated water will be worth \$0.42, and \$0.5/m^3 once routed to San Diego

In November 2002, SDCWA laid the foundations of an agreement with the Poseidon Resources Corporation to build and operate the biggest desalination plant of the western world. This 69 millions m^3 capacity plant would be able to meet 112,000 people demand, at \$0.6437/m^3 full cost. Though this plant will not offset the county water deficit, it augurs well for this process as a solution.

The SDCWA desalination strategic choice could also lead to significant change regarding the Authority's activities. The first desalination cost driver lies in energy consumption. In October 2001, our interlocutors from SDCWA were studying closely to enter the electricity market in order to lower the desalination cost and to put San Diego free from electricity deregulation negative impact.

5 SAN DIEGO AND LOS ANGELES WATER SUPPLY STRATEGIC CHOICES

In San Diego, conservation and recycling will release 40 millions m3 by 2020, enough to meet demand of 180000 people or 45% of the forecated demographic growth. The SDCWA initiatives (Metropolitan water allocation regime, IID agreement on the water market, and Poseidon agreement) are likely to half reduce the forthcoming San Diego deficit by 2010 in case of drought, and lower it up to one third under normal pluviometric conditions. In other words, one out of three San Diego inhabitants would be out of water in 2010 and at least one out of 15, even though SDCWA is successful in all its enterprises.

In economical terms, the San Diego water supply cost will not be as continuous as it has been (\$0.35/m^3). From 2005, it will range from \$0.3487/m^3 (35 millions m^3 - IID agreement) up to \$0.6437/m^3 (34 millions m^3 – Poseidon agreement), going through Metropolitan basic rate, \$0.3689 (742 millions m^3), Metropolitan higher rate, \$0.4248 (55 millions m^3), and recycling (24 millions m^3 at \$0.4685 in average). This new cost structure allows the San Diego Department of Water to set up a more progressive rate structure that may increase conservation.

Los Angeles is only at risk in cases of drought. Besides, the LADWP is ready to come onto the water market and to undertake desalination : it is connected to both the Colorado River and the California Aquaducts and produces enough electricty to operate a desalination plant. For the moment, Los

Angeles has made the bet to develop the cheapest water that comes out of conservation and expects huge rate increases in case of drought to offset its deficit.

Table 6. Los Angeles rates in case of drought

Water deficit	10%	15%	20%	25%
Rate \$/ m^3	1.3066	1.5680	1.8293	2.1365

A 4.5 liters lower consumption per capita per day would be enough to offset the expected 2005 deficit and a 142 liters lower consumption per capita per day to offset the expected 2020 deficit. The highest rate that would be applied in such a case, \$2.1365/m^3, may be big enough to reduce the average consumption down to 420 l/c/d.

6 CONCLUSION

Since the 1987-1992 drought, the water uses competition has intensified and enhanced the value of a scarcer resource. Urban water services internalise this value in order to figure out most cost-effective water supply to develop. The economic value of the water resource is passed on to consumers through progressive rate structures related to the incremental water supply cost.

The economic value of water as a water management tool has been efficient in California. The rate adjustments that have resulted from the increasing water supply costs have led to major conservation. While the former demand levels left room for substantial conservation, it is important to note that the economic value is relevant :

- In a region where inhabitants can afford a resource whose protection depends on increasingly sophisticated technics. Elsewhere, the spreading of market mechanisms all along the drinking water supply chain leads to full cost local rates that may be socially and politically unsustainable ;
- For local services which already pass on their full cost to their consumers. In Los Angeles and San Diego, water rates adjustments have not been as severe as they would have been if both services had to simultanously pass on water resource, transportation, treatment and distribution costs to their consumers. This is probably one of the reason why the economic value of water resource only concerns drinking use. The farmers that consume 80% of the Californian water have never been charged the full cost for the water they use. The aquaducts that were built up for agricultural purpose (Central Valley Project, All-American Canal and Coachella Canal) were funded by the Federal State. Agricultural districts just have to deal with the maintenance costs. The water lost by the agricultural aquaducts reveals the wastings that a resource considered as inexhaustible as almost free may be subjected to. The first IID-SDCWA agreement in 1998 was about the annual transfer of 247 millions m^3 that could be conserved from the All-American Canal repairs. This volume would have met demand of 1 million people in Southern Californian.

REFERENCES

Black & Veatch Corporation, 2000, *Water & Wastewater Rate Survey – 50 largest cities*

Cal. Department of Water Resources, may 1957, *The California Water Plan, Bulletin n°3*

Cal. Department of Water Resources, 1995, *Implementation of the Monterey Agreement*

Cal. Department of Water Resources, 1998, *The California Water Plan Update, Bulletin 160-98*

Cal. Department of Water Resources, 2001, *Management of the California State Water Project, Bulletin 132.99*

Cal. Department of Water Resources, 2001, *California's State Water Project*

Cal. EPA, State Water Resources Control Board, Division of Water Rights, 1999, *A Guide to Water Transfers*

Cal. EPA, State Water Resources Control Board, Division of Water Rights, 2000, *How to File an Application to Appropriate Water in California ?*

Cal. EPA, State Water Resources Control Board, Division of Water Rights, 2000, *The Water Right Process*

Cal. EPA, State Water Resources Control Board, Division of Water Rights, 2001, *A Guide to California Water Right Appropriations*

City of Los Angeles - Department of Water and Power, 2000, *Urban Water Management Plan*

City of San Diego - Water Department, 1997, *The Strategic Plan for Water Supply 1997-2015*

City of San Diego - Water Department, 2000, *The 2000 Urban Water Management Plan*

Metropolitan Water District of Southern California, 2000, *The Regional Urban Water Management Plan for the Metropolitan Water District of Southern California*

Metropolitan Water District of Southern California, 2001, *Rate Structure Proposal to the Board of Directors*, confidential document, October

Metropolitan Water District of Southern California, 2002, *Report on Metropolitan's water supplies*

Metropolitan Water District of Southern California, 2002, *Annual budget 2002-2003*, *executive summary*

Metropolitan Water District of Southern California, undated document, *Colorado River Resources : Challenges and Choices for California*

Pezon C., 2002, La gestion de l'eau en Californie entre marché et développement durable – le Metropolitan District of Southern California, rapport pour l'OTAN, Paris, CNAM

San Diego County Water Authority, 2000, *The 2000 Urban Water Management Plan*

San Diego County Water Authority, *Water Authority Board approves desalination term sheet*, Press releases, November, 14 2002

This work also relies on interviews conducted in October and in December 2001 with :

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