Interest for Transbay transportation: success key factors for the
development of this transportation mode, passenger boats (actual
design and recent impacts of reglementation on design)

Olivier Crouzier, Urban Transport Senior Economist, Urban authority of Toulon Provence Méditerranée, France

RESUME:

Lorsque le développement urbain au long d’un fleuve ou d’une rade le nécessite, le recours respectivement à une desserte urbaine fluviale ou maritime avec des bateaux à passagers peut s’avérer extrêmement pertinent. En effet, les temps de desserte sont réduits et extrêmement compétitifs par rapport aux transports terrestres. Une analyse du potentiel marché, des facteurs clefs de succès de ce type de transport ainsi qu’une monographie des villes ayant mis en œuvre de mode de transport (Hong Kong, Istanbul, Athènes, Naples, Toulon, Vancouver, Sydney), sont présentés. Au-delà de cette monographie, TPM propose de monter – avec les partenaires intéressés - un observatoire permanent du marché (autorités organisatrices, consultations, contrats en cours, exploitants, architectes navals, chantiers navals des bateaux à passagers).

ABSTRACT:

This paper reviews cross-bay or cross-river transport. The key success factors for the development of this mode focus upon the passenger boats and their actual design and recent impacts of regulation upon designs. Whenever the urban development along a river or a marine bay seeks improvements in the transport systems, then the reinforcement of transportation system, development of marine-based transport may be appropriate for some travel and commuting solutions.

A key advantage is that river-based transport offers reduced travel time and also is cost-effective, when compared with road-based transport with the attendant cost of highways, bridges, tunnels and other expensive infrastructures.

The study uses key success assessment criteria to compares systems in different cities which possess river and estuarial ferry systems, including Istanbul, Hong Kong, Naples, Toulon, Vancouver and Sydney.

The urban authority in Toulon, the Toulon Provence Méditerranée plans to create a permanent study of this transport sector and, with all the concerned partners, it will develop a general database related to this cluster to create an inventory of the urban authorities, types of contracts, bid for tenders, marine architects and boat design recommendations, …)

With the advices of

Graham Fletcher, Independent Consultant for governments, municipalities, Corporate membership (Chartered fellow), Chartered Institute of Logistics and Transport, Member of the Institute of Transport Engineers, London UK, General manager of Oman National Transport Operations (1974-1994)

Michel Gallet, Eres-Ingetrans, Expert in Transbay and cross river Urban Transport, Consultant for governments and municipalities

Etienne Marchal, Development Manager of RMTT Toulon’s urban network, Group Veolia Transport, Urban Transport Expert

"Development of Transbay transport (bays, channels, rivers): state of the art, success keys factors, passengers Shuttles (current conception and evolutions)"
1. **Potential of maritime, river or lakeside urban transport**

Whenever urban communities are located upon a coastal environment that includes lakes, rivers, canals or rivers, then ‘Transbay’ urban transport using these water-borne facilities can be considered.

According to the river or maritime bay crossing distances considerations, Transbay covers essentially three sets of opportunities as shown in the schematic below:

In Canada, the local term is “short distance sea transport” to differentiate transport on the Saint Lawrence River system from the transatlantic sea transport.

However, Transbay urban transport applies mainly to ferry transport across enclosed bays, such as those in to configurations of almost closed Bays (Sydney, Toulon and Brest or as in Venice Laguna, Pointe à Pitre’s bay in Guadeloupe, Fort of France’s Bay in Martinique or wide open bays in Hong-Kong, Naples or even the straits as Bosphorus connecting the European and Asian sides of Istanbul.

It is possible to apply Transbay concepts in many geographically diverse areas such as the river estuaries of the Saint Laurent, the Loire and the Erdre in Nantes, Bouregreg in Rabat, and the Tagus in Lisbon, and also concerning the connections with nearby islands such as Frioul’s islands in Marseille and the islands between Vancouver and Victoria

Success in implementing public sea and river transport relies largely on the development of a carefully designed maritime/river/lakeside transport network, respecting **identified key success factors** in service design:

- The potential of the pre-existent market, where high population density exists on each shore that the ferry serves.
- The use of the safest direct ferry crossing between terminals without any intermediate stop point so that fast links are created when compared with road-based alternatives.
- Service availability in all-weather conditions,
- Convenient and attractive park and ride facilities at the terminals, together with convenient links with bus, tram and train services.

Co-ordinated planning between the different modes is essential so that both ferry operators and other public transport operators and their passengers gain from the interchange between modes.

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"Development of Transbay transport (bays, channels, rivers): state of the art, success keys factors, passengers Shuttles (current conception and evolutions)"
2. **General review of cities with Transbay or Islands maritime network**

A general review of cities which operate Transbay urban transport has been made.

**In France:** Brest, Lorient, Nantes, Toulon Marseille, Nice and La Rochelle. Remember from Pagnol’s movies the ferries that link both banks of Marseille’s urban port area?

**Brest-Crozon maritime line**

For one year only, the military maritime daily shuttles connecting Brest with Lanvéoc accepted civilians on board. Although it was abandoned and the civilians no longer have access to the military maritime shuttles which connect Brest to the peninsula of Crozon (Lanvéoc). The experiment led by the Navy, in partnership with Manche Department, will thus have lasted only on one year. “This term was scheduled. The experiment last twelve months "mentioned a naval headquarters official. And experiment is over. For the moment at least”

Why not going on longer with the experiment? The General Council and the Navy explain this sudden halt by the low levels of patronage. As only 914 swipe cards were distributed to civilians in the peninsula of Crozon, only a few civilians regularly used these military-run ferries.

“Five a day was the average passengers carried”, the spokeswoman of the maritime prefecture stated.

The Department offered a preferential rate: 2 € for the ferry crossing plus an annual charge of 5 € for the swipe card.

Whilst the ferry crossed the natural harbour within half an hour, regrettably, the time schedules were not adapted to the requirements of the civilian public.

The terminal jetties were located far distant from urban areas they served, unfortunately extending the journey time.

*Were these two inconvenient characteristics unbearable? Not really …*

*"Development of Transbay transport (bays, channels, rivers): state of the art, success keys factors, passengers Shuttles (current conception and evolutions)"*
Lorient’s urban transport network in Brittany

The CTRL network is linked by buses and maritime shuttles (Batobus) across the 19 municipalities of the Urban Community of Cap l’Orient with approximately 180,000 inhabitants: Brandéron, Caudan, Cléguer, Gâvres, Gestel, Groix (Island of), Guidel, Hennebont, Inzinzac Lochrist, Lanester, Larmor Plage Languidic, Locmiquélic, Lorient, Ploemeur, Port Scorff, Port Louis, Quénec and Riantec.

Note: Maritime shuttles between Lorient and the island of Groix are not integrated into the network of public transport although bus lines on the island do form part of the CTRL network

Nantes urban transport network

Three river shuttles, identified as Navibus, are in service at the moment in the town of Nantes. As these ferries form part of the Nantes urban public transport network [TAN], the possession of a valid ticket is necessary to be allowed to make the crossing. All the TAN travel products are accepted on the ferries although it is also possible to buy a one way or round trip ticket on board.

Navibus on the River Loire
Trentemoult and the centre of Nantes are connected in 10 minutes by the Navibus Loire. The shuttle can carry 95 persons and 10 cycles and provides the link between "Trentemoult-Roquios " Rézé (lines 30 and Microbus) and the Harbour station in Nantes (correspondence bus lines 1, 81 and Express line "Couéron")
At Trentemoult, two shuttle services link with the car parks at Port of Trentemoult (75 places), and the TAN bus station on Ordonneau street - 90 places.

Navibus on Erdre’s river
In addition, the Navibus shuttle, which can carry 90 persons and 10 bicycles, links every 30 minutes between South station to Saint-Mihiel and at weekends between South station and Jonelière.
Navibus Passeur
This shuttle provides a crossing of the Erdre between Port Boyer and Petit Port. The 2 minutes crossing is made by a boat which can carry 12 passengers and 4 bicycles on demand by ringing a bell (French technique !)
Semitan and Navibus received the Territorial awards in 2006 in the category of local development, awarded by the National Observatory for public Innovation in recognition of the innovative quality of the works, the capacity to be transposed to other urban communities and the good use of the public funds.

Toulon’s urban network and Transbay lines (more detailed description in page 13)

The Mistral network is among the most developed cross-bay ferry systems in France – it operates in Toulon on a 5 km diameter Inner Bay known as the “Petite rade”. Operations and maintenance is undertaken by to RMTT (Régie Mixte des Transports Toulonnais) under an operating and maintenance contract that includes industrial and commercial risks.

The Mistral network includes 55 surface transport routes and 3 ferry services.
- 28 M: Toulon/St Mandrier line (1700 trips/day)
- 8 M: Toulon/La Seyne line (1000 to 1100 trips/day)
- 18 M: Toulon/ Les Sablettes (850 to 2850 trips/day respectively in winter and summer season)

Main figures related to Transbay lines are:
- Approximately 130 boats trips/day with noticeable daily and seasonal variations
- 4000 passenger trips / day on average (5500 in summer day)
- Maritime Shuttle park is in the course of modernization with recent starting of 2 new shuttles (in 2004 and 2005) and 5 new hybrid shuttles (diesel and electricity) in the new five years.
- Occupancy ratio around 4.5 per seat.km for the best lines, ratio which overtakes by far the value of good ground lines (2.5).

- In Europe: Hamburg (Germany), Oslo (Norway), Copenhagen (Denmark), Goteborg (Sweden), Athènes/Le Pirée (Greece), Lisbon (Portugal), Istanbul (Turkey), Naples (Italy) and Venice with its Lagoon.

Hamburg HADAG ferries

With a workforce of 85 and 19 vessels on 6 lines with 21 stopping points, HADAG provides a reliable harbour ferry service for HVV 365 days a year - in wind, high water, ice and fog alike. HADAG is fully owned by Hamburger Hochbahn AG. Of its workforce, 44 currently belong to the AG (BAT pay scale) and 42 to HADAG Verkehrsdiestre GmbH (company pay scale).

HADAG increased passenger numbers on harbour ferries by 130% from 1997 to 2005.

From the historic harbour barques, which were manned by just one person, HADAG has - over several stages - developed its modern ‘2000’ type one-man ferry.
These vessels have a capacity of 250 and offer disabled access, WC, stowage space for bicycles and, with the mini-slide installations, additional rescue equipment. Whenever the design is discussed passengers praise the comfort and convenience offered to passengers. 8 boats of this type are currently in use on Line 62 to Finkenwerder (1/4-hour cycle), while a ninth is under construction.

"Development of Transbay transport (bays, channels, rivers): state of the art, success keys factors, passengers Shuttles (current conception and evolutions)"
Oslo Transport Network

Oslo is connected all year round by the sea and its port is dealing on a high level with circulation of goods as the passengers. Ferries provide linkings with Kiel, Fredrikshaven and Copenhagen.

Copenhagen Transport Network

The nearby islands are connected with the mainland and interconnected by an important network of ferries.

Goteborg Transport Network

Numerous ferries for Germany and Danemark (but they may not be considered as Transbay routes)

Athènes-Pyreus

The local ferry network is excellent and cheap. To travel to and between the main islands, there is a choice between ferries and hydrofoils. The hydrofoils are twice as fast but are also twice as expensive for passengers. The Piraeus, the largest port of Greece has connections with almost all the islands, with the exception of the Ionian Islands which are linked by Patras, Igoumenitsa and Prévéza.

Connection Lisbon other side of the Tagus

Several jetties are available for ferry passengers to take a shuttle to the other side of the Tagus (Outra Banda) where many Lisbon inhabitants live, and where local property prices are lower.

Istanbul (connections between the western and oriental banks)

<table>
<thead>
<tr>
<th>ISTANBUL</th>
<th>University of Technology</th>
<th>Palatine Bridge</th>
<th>Mosques</th>
<th>Sirkeci Station</th>
<th>University of Istanbul</th>
<th>Port of Istanbul</th>
<th>University of Istanbul</th>
<th>Port of Istanbul</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AERIAL</strong></td>
<td>Airports</td>
<td>Sanahin</td>
<td>Galata Bridge</td>
<td><strong>BOSPORUS</strong></td>
<td>Port of Istanbul</td>
<td>Galata Bridge</td>
<td>Port of Istanbul</td>
<td><strong>BOSPORUS</strong></td>
</tr>
<tr>
<td><strong>MARMARA</strong></td>
<td>Mer de Marmara</td>
<td><strong>BOSPORUS</strong></td>
<td>Port of Istanbul</td>
<td><strong>BOSPORUS</strong></td>
<td>Port of Istanbul</td>
<td>Galata Bridge</td>
<td>Port of Istanbul</td>
<td><strong>BOSPORUS</strong></td>
</tr>
</tbody>
</table>

The ferries are under-used and run at only about 50% of capacity, which is in sharp contrast to the road traffic which has grown continuously since the 1950s. Fortunately, the ferry services are part of traditional Istanbul, and cannot be excluded from future public transport policies.

Furthermore, the improvement of the ferries requires the creation of new lines and the reduction in ferry crossing times to compete with buses using reserved lanes on the bridges during peak periods. Public transport requires both a network of bus and sea transport services each with high quality services and by developing professional planning of the public transport facilities and services.

Istanbul has most public transport modes, including buses, railways and ferries - and has transport infrastructures which has not successfully remedied the chronic traffic congestion.

To place the demand characteristics in context, it should be noted that more half of the population lives on the Asian [Anatolian] side of the City but about 90 % of the population works on the European side where most of the working centres are situated. There is a current trend to develop educational campuses in the Anatolian side of the City although most of the older public universities, cultural and training Centres are located on the European side of the City.

Nowadays, the crossing of Bosphorus is provided by two bridges, the Bosphorus Bridge and the Fatih Bridge which carry around 80 % of the traffic, the traditional ferries carry the remaining 20 %.

*Development of Transbay transport (bays, channels, rivers): state of the art, success keys factors, passengers Shuttles (current conception and evolutions)*
The railway tunnel under the Bosphorus / Sea of Marmara is used by mass-transit commuter trains and also connects the Asian and European rail networks within Turkey. At the same time the tunnel will also be used by commuter trains on the Gebze-Halkali railway line.

The rail tunnel under the Sea of Marmara is expected to be opened in 2010. The passenger transport capacity of this new link will be ten times greater than the existing bridges, with a carrying capacity of 75,000 passengers per hour.

Istanbul possesses 111 km of railway infrastructures, among which 72 kms are commuter lines. They represent less than 6 % of the total passenger trips and their place is limited with regard to the road vehicles. Bus, light rail and subway services are also being developed, but concentrated on the European side of the City.

In Istanbul the public urban transport uses many modes, including buses, public and private sector buses, ferries, underground metro trains, commuter trains, streetcars, taxis and also dolmus collective taxis.
The fare varies on different modes.

**Akbil**

Akbil is a reloadable ticket and durable product, using magnetic trip technology, colour-coded to allow passengers to use different public transport modes. They can be purchased at some stops and at termini.
The basic fare is 6 YTL, but by purchasing an Akbil, a 20 % reduction is applied in municipal buses, public buses, ferry services, tunnel, LRT, subway, and the commuter trains on the European side of Istanbul.

**Ferry Services (“maritime buses”)**

Ferries are the fastest means of transport and are ideal for the long routes between both shores of the Bosphorus, islands and many local urban communities. Passengers can purchase ordinary tickets or use the discounted Akbil ticket products.

**Shuttle boats**

These are ancient steam ferries which cross the Bosphorus. 1.10 YTL tokens of, can be bought at the entrance of jetties (Iskele), although the Akbil product is also valid with a 30 % reduction.
The fare is different for the Princes Islands route and the cruise along Bosphorus, although the reduction by using the Akbil remains at 30 %.

**Maritime transport in Venice and its Laguna**

Public transportation in Venice is mainly represented by the Vaporetto services.
2 main lines are n°1 (which links all the stations and n°82 (the fastest). At night, the line N operates from 11:30 pm till 4:00 am in the morning.

"Development of Transbay transport (bays, channels, rivers): state of the art, success keys factors, passengers Shuttles (current conception and evolutions)"
In 2005, a one-way trip costs 3.50 € but does not pass through the Grand Canal and the centre of Venice. A ticket for traversing the Grand Canal is 5€ single and 6 € for the round trip. There are unlimited use, tickets at €10.5 for 24 hours or € n22.00 for 3 days travel. With these tickets, passengers may travel also to Murano or Burano.

It should be noted that these unlimited use tickets are effective from when they are purchased and not from first use, and thus it is necessary to buy them just before intended travel tickets are for sale at the main stops, tobacconists and information offices, although they close at around 21.00 or 22.00 in the evening.

The ACTV Company manages the public transportation of Venice:
Address: Santa Croce, Piazzale Roma.
Web site: http:// www.actv.it/.
Site of Venice's municipality

**Traghetto.**
These boast travel from a one bank to the other one for less of 1€, but with the inconvenience of standing up throughout the entire crossing!

**Gondola**
This is a more romantic but a very expensive option. Count between 60 and 80 euro for the stroll of 50 minutes leisurely trip. If there is a musician on board, the price will double, although the price of gondolas is officially fixed

**Taxi-boat**
These magnificent traditional and varnished wooden boats are extremely expensive and cost at least about 50€ for the slightest route.

**Car parks**
Don’t use your car in Venice because it is both ineffective for travel and also car parks are very expensive with an average cost of € 20.00 for 24 hours.
A cheaper solution is to leave the car at one of the Mestre car parks of then take the public transport to Venice.

Except for Traghetto, public transport in Venice is relatively expensive.

**Naples maritime subway**

Naples bay accounts three islands: Capri in the South (the most touristic and famous one) Ischia and Procida in the North. These islands are accessible by boat from the port of Naples, Mergellina and Pozzuoli. Procida, the smallest of three islands, remains the most authentic and attracts less tourists. There is in Naples a so called « maritime subway » metro system which serves 17 stations between Bacoli and Sorrente.

“Development of Transbay transport (bays, channels, rivers): state of the art, success keys factors, passengers Shuttles (current conception and evolutions)”
In Asia: Hong-Kong, Singapore, Sydney, Ho Chi Minh

Hồ Chi Minh City and Mekong

Using waterways is sometimes faster than travelling by roads. High speed 40-passenger boats connect Hồ-Chi-Minh-City with Vung Tau, Can Tho and Châu Đốc.
They are operated by the Chieu Phuc Ferry company. The departures are from Bach Dang quay (on Tuesdays, Thursdays and Saturdays. Journey time is 6 hours and the ticket costs 250 000 dongs /passenger.

With this new route, four high speed ferry services operate to Vung Tau, Can Tho, Soc Trang and Chau Doc.

Hong-Kong and the nearby islands

(Information from General Consulate of France in Hong-Kong and Macao)
Hong-Kong has developed on both sides of Victoria Bay and possesses numerous nearby islands. Short sea crossing links are well developed with frequent ferries crossing the bay and linking the main communities of Hong-Kong and Kowloon.

The major ferry operator is Star Ferry. The ferries are very frequent and cheap. They connect Tsim Sha Tsui, on Kowloon to Central or Wanchai, on the island of Hong-Kong. The Hong Kong-Kowloon crossing takes ten minutes, and it operates from 6 am in the morning till 11 pm, charging 2.20 HKD for the superior deck and 1.70 HKD on the lower deck. In addition, there are frequent boats from Central or Tsim Sha Tsui to various islands including Lantau, Lamma and Cheung Chau as well as other ferries to Macao and as far as Canton and Zhuhai.

"Development of Transbay transport (bays, channels, rivers): state of the art, success keys factors, passengers Shuttles (current conception and evolutions)"
Sydney bay ferry services.

Point of departure of Sydney ferries run from Circular Quay, close to the Sydney Opera House, with some trips also calling at Darling Harbour.
Sydney Pass or See Sydney and Beyond tickets with inclusive transport offer unlimited travel on these ferries which operate across the bay in all the directions all day long and it is one of the best ways to discover Sydney.

. In North America: New York, Vancouver, Quebec, ...

National Census of Ferry Operators in the US (from Highlights of the 2006 National Census of Ferry Operators (reference 1)
Ferry service is primarily located in states with extensive coastline or inland waterways. In 2005, the majority of ferry routes travelled within a state (81%).
The median length of a ferry route is 5.8 miles and the median travel time is 30 minutes per ferry route. The states of New York, Washington, California, Michigan, New York and Washington accounted for 2/3 of all US ferry passenger capacity.
Nevertheless, a distinction has to be done between Transbay/Cross rivers ferry services and other services.

From Staten Island to New York
The municipal ferry service to Staten Island began in 1905 and operates 24 hours a day and offers 104 trips on weekdays and 64 at weekends.
The 8.4 kilometres trip takes about 25 minutes and offers a beautiful panorama of the island of Manhattan. It is best to take the ferry in the evening, just before sunset. The ferry to the Statue of Liberty and to Ellis Island starts from Port Clinton located at Battery Park at the end of Manhattan. The trip costs price USS 7.00 for adults and US$ 3.00 for children, and includes entry to the museum on Ellis Island.

"Development of Transbay transport (bays, channels, rivers): state of the art, success keys factors, passengers Shuttles (current conception and evolutions)"
Vancouver’s SeaBus ferry service

Vancouver’s unique SeaBus ferry service went into service on 17 June, 1977. This efficient commuter service carries five million passengers a year between Vancouver and North Vancouver (a distance of 1.75 nautical miles). In 2001, the SeaBus system carried its 100 millionth passenger. Its heritage dates from mid-1800s when a ferry linked Vancouver and what was then known as Moodyville but which became North Vancouver in 1907.

For the price of a regular fare transit ticket (presently between $2.25 and $3.50 CDN), SeaBus passengers enjoy a view of both Vancouver’s skyline and the North Shore mountains, plus a close-up look at marine traffic operating.

The SeaBus vessels and terminals were the first marine transit system of its kind in the world when they were built. The twin SeaBus vessels - the Burrard Otter and the Burrard Beaver - link the downtown Vancouver and North Vancouver terminals with 126 one-way trips daily. They are double-ended, aluminium-hulled catamarans, each powered by four diesel engines. Extremely stable, the ferries can actually move in any direction including sideways due to the four swivel props, one at each end of the pontoons. This lightweight design and ingenious propulsion system means that they are able to stop in their own length. Designed double-ended, either end can become the stern or the bow in an instant and the controls are duplicated on both sides of the captain’s 360-degree swivel chair. The joystick controls use ‘dual steering synchronisers’ (DSS) to synchronise the rotation of the four prop modules.

Operated by a crew of four, SeaBus travels at a cruising speed of eleven and a half knots, crossing the harbour’s one-and-three-quarter nautical miles in 12 minutes.

For passengers arriving at the North Vancouver terminal by bus or at the downtown Vancouver terminal by bus or SkyTrain, their transfer is quick and seamless.

The terminals each have two berths with a waiting room between for boarding passengers. Each berth has six ramps per side. Once the SeaBus is in the slip the six ramps on one side are lowered into place and the wide doors open allowing the full load of passengers to exit smoothly and efficiently.

This is controlled from on board the vessel so that once the cabin is clear the six doors on the opposite side are opened and the return passengers board. Since the passenger seating area is a single deck, the offload and load of passengers is completed in less than two minutes. The boats’ compact pilothouses are suspended above the passenger area and have a small outside wing area for a lookout in the foggy weather that is common in the late fall.

British Colombia maritime routes

The network of ferries in British Columbia serves at least 47 ports by routes along the coast. Crossings between Victoria Island and Vancouver on the mainland take between 90 and 120 minutes, dependent on the chosen route. There are three options, with several services operating all year around.

Short distance ferries on the Saint Laurent’s River

Most crossings relate to freight transport than for the carriage of passengers.

*Development of Transbay transport (bays, channels, rivers): state of the art, success keys factors, passengers Shuttles (current conception and evolutions)*

11
**Dubai City**

Urban sea transport is provided in Dubai by wooden boats-shuttles called Abras. Abras were the main means of transport across the natural harbour before cars crossed the creek by various bridges or more recently the tunnel at A’Shindagha. The Abras remain very popular, carrying 15 to 20 million passengers a year.

The maritime service is under the control of the Dubai Roads and Transport Authority (DRTA). The ancient pontoons have been replaced by 6 official harbour stations with control barriers, maintained by the Municipality of Dubai. The ferries operate between 5:30 and midnight, on 3 different crossings with up to 10 departures per hour. Travel time of crossing at Burj Dubai is about 10 minutes. The fare is one dirham by the public ferry and 100 dirham per hour for the exclusive hire of the boat. The DRTA plans to increase fares and to use gas-powered or solar energy vessels.

**In the Caribbean**
*(From Tourist Guide)*

Fort-de-France in Martinique does not have that kind of “paradiisacal island charming image” that could be expected. The city is surrounded by densely populated hills with many tin-roofed shacks and also suffers from chronic traffic jams, due to this high concentration of industrial and commercial centres in Fort-de-France.

The best way of discovering the city is to use the local ferries that provide a shuttle service linking Fort-de-France with the south of the island, at Trois-Ilets.

Approaching the city by ferry, the full panorama of the bay of Fort-de-France can appreciated at its best.
3. The natural advantages of Transbay connections, potential market appraisal and technical feasibility

3.1 Toulon’s urban network and Transbay lines

The Mistral network is among the most developed cross-bay ferry systems in France – it operates in Toulon on a 5 km diameter Inner Bay known as the “Petite rade”.

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- Maritime Shuttle park is in the course of modernization with recent starting of 2 new shuttles (in 2004 and 2005) and 5 new hybrid shuttles (diesel and electricity) in the new five years.
- Occupancy ratio around 4.5 per seat.km for the best lines, ratio which overtakes by far the value of good ground lines (2.5).

"Development of Transbay transport (bays, channels, rivers): state of the art, success keys factors, passengers Shuttles (current conception and evolutions)"
Shuttles fleet servicing these three lines consists of 12 ships, with the following average characteristics of the vessels:

- Number of passengers: 100 to 160 passengers
- Overall length: 16.5 - 22 m
- Draft: 0.92 to 1.40 m
- Outboard width: 4.20 to 5.70 m
- Power: 2x 215 to 2 x 450 CV
- Weight: 20 in 32.5 tons

3.2 Natural advantages of Transbay connections, market share

In Toulon, the Transbay ferries carry around 1.4 million passengers per year.

A quick analysis of the Toulon Centre - Saint Mandrier corridor demonstrates clearly the advantages of the boat (figure 1). The comparison between the car, the bus and the ferry shows that the journey time in boat is the quickest.

Regardless of traffic jams, travel time by car to drive the 15 km between Saint Mandrier and Toulon is 25 minutes.

On this corridor, bus travel time is about one hour and is not convenient, except for destinations just a short distance from the coast and in the specific case of passengers with no alternate mode to use. For example, only 25 passengers/day are carried on the bus route linking Toulon and Saint Mandrier.

The Transbay ferry has a modal share to Saint Mandrier of 12%, taking in consideration that not all the cars are going to downtown Toulon.

"Development of Transbay transport (bays, channels, rivers): state of the art, success keys factors, passengers Shuttles (current conception and evolutions)"
3.3 Transport Market demand in the inner bay of Toulon

The analysis of trips (any mode, any motive) provides an understanding of the overall transport market among the various municipalities. The potential market must be examined through an analysis of accessibility to the jetties used by the ferries.

Annual usage of 3 Transbay routes is 1.4 million passengers and 265000 passenger-kms/year.

The productivity of the Transbay ferries is remarkable (4.6 passengers per km with a peak in 5.46 in summer) to be compared with the average rate of 1.9 passengers per km for the total network.

2% of the Mistral network - Toulon’s urban network is associated with 6% of use in the Mistral network.

3.4 Conditions of wind and navigation

Ferry transport needs favourable wind and sea state, which are provided by the quasi-enclosed natural harbour of Toulon.

The following table portrays the wind state from the wind measuring stations of the coast TPM (the direction and strength of the wind in knots)

<table>
<thead>
<tr>
<th>Spot</th>
<th>vents 17 à 21 naux</th>
<th>vents 22 à 27 naux</th>
<th>vents + de 27 naux</th>
<th>vents inférieurs à 17 naux</th>
<th>Orientation</th>
<th>Variabilité directionnelle ou constance</th>
<th>Période observation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toulon le Mitre</td>
<td>9,4</td>
<td>2,7</td>
<td>0,6</td>
<td>87,3</td>
<td>Ouest</td>
<td>peu régulière</td>
<td>01-01 à 12-01</td>
</tr>
<tr>
<td>St Mandrier-vigie de Capet</td>
<td>12,1</td>
<td>7,8</td>
<td>7,3</td>
<td>72,8</td>
<td>Ouest</td>
<td>très régulière</td>
<td>01-01 à 12-01</td>
</tr>
<tr>
<td>Hyères le Polyvaestre</td>
<td>6,7</td>
<td>1,7</td>
<td>0,3</td>
<td>91,3</td>
<td>Ouest</td>
<td>régulière</td>
<td>01-01 à 12-95</td>
</tr>
<tr>
<td>Hyères Porquerolles</td>
<td>11,9</td>
<td>8,3</td>
<td>6,5</td>
<td>73,3</td>
<td>Ouest Est</td>
<td>peu régulière</td>
<td>01-01 à 12-03</td>
</tr>
<tr>
<td>Hyères Levant</td>
<td>11,8</td>
<td>8,2</td>
<td>9,2</td>
<td>70,8</td>
<td>Ouest Est</td>
<td>peu régulière</td>
<td>01-01 à 12-01</td>
</tr>
</tbody>
</table>

At Mitre’s which records wind information in the inner bay of Toulon (“La Petite Rade”), 87.3% of recorded winds are lower than 17 knots.

Wind speeds above 27 knots can cause service cancellations, although within the “Petite Rade” it is exceptional to have to stop maritime services (only on 1 or 2 days by year).

The creation of dedicated jetties or quays requires an analysis of the sea conditions prevailing; it is then necessary to take account of wave height fluctuations at the proposed terminal sites.

The table below shows the effect of the local wind characteristics at the various ferry terminal sites proposed.

<table>
<thead>
<tr>
<th>Site</th>
<th>Incidence</th>
<th>Fetch</th>
<th>Année</th>
<th>J-J-A-S</th>
<th>Long.</th>
<th>Prof.</th>
<th>Vent</th>
<th>M/s</th>
<th>h/s</th>
<th>t/s</th>
<th>Dm</th>
<th>Vent</th>
<th>s/m</th>
<th>t/s</th>
<th>Dm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toulon</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Tour Royale</td>
<td>N</td>
<td>1.6</td>
<td>10</td>
<td>26.5</td>
<td>3.0</td>
<td>15</td>
<td>18.9</td>
<td>10.0</td>
<td>2.5</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>W</td>
<td>3.5</td>
<td>10</td>
<td>30.5</td>
<td>3.6</td>
<td>25</td>
<td>26.5</td>
<td>1.20</td>
<td>3.5</td>
<td>25</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>SW</td>
<td>3.1</td>
<td>10</td>
<td>34.5</td>
<td>3.8</td>
<td>20</td>
<td>18.9</td>
<td>0.80</td>
<td>3.0</td>
<td>30</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 Saint-Mandrier</td>
<td>N</td>
<td>2.1</td>
<td>10</td>
<td>26.5</td>
<td>3.2</td>
<td>20</td>
<td>18.9</td>
<td>0.70</td>
<td>2.7</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>N-NW</td>
<td>3.7</td>
<td>10</td>
<td>30.5</td>
<td>3.7</td>
<td>25</td>
<td>26.5</td>
<td>1.25</td>
<td>3.5</td>
<td>25</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 Les Sablettes</td>
<td>N-NE</td>
<td>4.0</td>
<td>4</td>
<td>30.5</td>
<td>3.4</td>
<td>25</td>
<td>30.5</td>
<td>1.20</td>
<td>3.4</td>
<td>25</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 Tamaris</td>
<td>S-SE</td>
<td>1.5</td>
<td>4</td>
<td>26.5</td>
<td>2.8</td>
<td>15</td>
<td>15.4</td>
<td>0.45</td>
<td>2.2</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>E (passe)</td>
<td>9.5</td>
<td>6</td>
<td>34.5</td>
<td>4.3</td>
<td>50</td>
<td>26.5</td>
<td>1.45</td>
<td>4.0</td>
<td>55</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>E-NE</td>
<td>2.1</td>
<td>6</td>
<td>30.5</td>
<td>3.3</td>
<td>15</td>
<td>30.5</td>
<td>1.10</td>
<td>3.3</td>
<td>15</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 Balaguer</td>
<td>E-SE</td>
<td>2.0</td>
<td>10</td>
<td>34.5</td>
<td>3.5</td>
<td>15</td>
<td>28.5</td>
<td>1.00</td>
<td>3.1</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>E-NIE</td>
<td>3.2</td>
<td>10</td>
<td>30.5</td>
<td>3.7</td>
<td>20</td>
<td>30.5</td>
<td>1.35</td>
<td>3.7</td>
<td>25</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 La Seyne/Mer</td>
<td>E-NE</td>
<td>3.7</td>
<td>7</td>
<td>34.5</td>
<td>3.9</td>
<td>25</td>
<td>30.5</td>
<td>1.35</td>
<td>3.7</td>
<td>25</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7 Bregaiion</td>
<td>E</td>
<td>3.7</td>
<td>7</td>
<td>34.5</td>
<td>3.9</td>
<td>25</td>
<td>26.5</td>
<td>1.15</td>
<td>3.5</td>
<td>25</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Development of Transbay transport (bays, channels, rivers): state of the art, success keys factors, passengers Shuttles (current conception and evolutions)*
Computations have been made according to the formulae of Bretschneider in 1973 and 1977 and the formulae of Hasselmann in 1976. Fetch is characterized by significant height H_s in the period of peak T_p and in relation to the minimal duration DM to establish a peculiar fetch conditions.

Due to the natural protection within the “Petite Rade” service area, the residual effect from large swells which approach Toulon, rarely pass through the main entry channel from the East South easterly direction.

Among the examined sites, only Tamaris harbour (protected by nearby shallow waters of fish farms) and Balaguier (essentially on the southern shore can be exposed)

**Shown below is an analysis of developing a jetty in La Seyne**

*Development of Transbay transport (bays, channels, rivers): state of the art, success keys factors, passengers Shuttles (current conception and evolutions)*
4. **Key success factors regarding Transrade**

MISTRAL - Toulon's urban network - was created within the inner bay of Toulon and offers a more efficient French Transbay network when compared to other French towns such as La Rochelle, Lorient, Brest, Bordeaux.

**Maritime "Transbay": a very significant potential for development**

For the record, keys success factors of the "Transbay" ferry transport are the following:

- **Advantage of "express" route**: Transbay shuttles provide shorter and quicker direct connections to destinations when compared with other road or rail based modes serving the inner bay which have to operate around the convex shape of the bay),

- **Existing traffic demand and conditions**: high density housing and employment exist in walking distance close to the ferry terminals (is the case of Toulon and Seyne) or with easy car access (Les Sablettes) or car parks nearby.

- **All weather conditions**: The inner bay of Toulon is only slightly affected by the Mistral and Tramontane winds and is protected from heavy swell waves by the large Jetty. These conditions allow crossings all year around. It is extremely rare to have to close ferries because of bad weather.

- **Easy accessibility to terminals**: it is very important to provide easy access to the jetties for the various modes (MAP, bicycles, buses or cars); the presence of convenient “park and navigate” facilities close by is very important conditions for success.

- **Frequent services**: At least every 30 minutes at peak hours depending on the potential demand

- **Clear information and promotion of the Transrade ferry services**

- **Well designed boats (and in good service conditions)**

**Key figures of the 2 alternate modes (bus and ferry)**

A comparison between common buses and ferries clearly highlights differences between the 2 modes:

<table>
<thead>
<tr>
<th>Comparison</th>
<th>bus</th>
<th>Ferry (shuttle)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commercial speed</td>
<td>17 to 25 km/h (average speed on a line)</td>
<td>6 to 8 knots (10.8 to 14.4 km/h) ...</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 times slower than a bus line</td>
</tr>
<tr>
<td>Investments</td>
<td>Standard bus: 200 k€ (100 passengers)</td>
<td>Ferry: 1 to 1.2 M€ (22 m, 100 passengers)</td>
</tr>
<tr>
<td></td>
<td>Articulated bus: 290 k€ (140 passengers)</td>
<td></td>
</tr>
<tr>
<td>Life time</td>
<td>10 to 15 years</td>
<td>20 to 30 years</td>
</tr>
<tr>
<td>Operating costs</td>
<td>2.1 - 3.24 € per km</td>
<td>8.87 € per km of navigation</td>
</tr>
<tr>
<td>Including maintenance</td>
<td></td>
<td>3 to 4 times more expensive</td>
</tr>
<tr>
<td>Attendance</td>
<td>4.5 passengers per seat.km</td>
<td>2.3 passengers per seat.km (average value for ground lines)</td>
</tr>
<tr>
<td></td>
<td>(2 times more attendance than in a bus)</td>
<td></td>
</tr>
</tbody>
</table>

Transbay ferries “equation” can be compared to buses “equation”: Two times slower than buses, extremely sensitive to weather and sea conditions (1 day off service in Toulon's inner bay ... but it could raise up to 20 days off service in other weather/sea conditions), necessitating more expensive investments (ferries and pontoons/piers) and at 3 or 4 times more expensive operating conditions than buses (1).

But, good news, the attendance is about two times the attendance you may expect in regular buses routes.

Taking in consideration this key figures, Transbay or cross-river success keys factors must be carefully analysed (navigating conditions, maritime route with a very clear distance advantage compared to bus routes, ...).

(1) Indeed, operating costs are very sensitive to wages level and energy costs (very different from one to country to one another ... ratios here-above mentioned may be significantly different in other countries)
5. The evolutions of the maritime shuttles (passengers boats)

5.1 Expectations of the passengers

Passengers expectations concern better conditions during the crossing (stability - decrease of the reeling/roll, pleasant temperature in winter/summer, the possibility of going out on the deck (upper deck if any), protection from sun, sheltering in case of wind, accessibility to people with reduced mobility and the possibility of loading bicycles).

Other users of the inner bay (for example: "on boat" residents in port equipped with a private jetty ask for a reduction of waves generated by the public ferries

And last but not least, the ferries are supposed to reduce their noxious smoke emissions of smoke notably at the start of trips (and during short navigation within departure and destination ports).

5.2 Characteristics of shuttles under construction and current shuttle fleet

The construction of 5 new ferries with mixed propulsion (with an electric engine have been launched by the TPM Urban Community with the cooperation of a naval architect.

A detailed functional specification was developed and then the technical specifications were then developed by the Naval Architect.

The “world sea cluster of competitiveness” localized in Toulon successively supported the feasibility studies/innovation Déesse (ferries moved by hybrid propulsion) and more recently Apache (project of manufacturing of hydrogen from a waste incinerator and design of shuttles propelled by a hydrogen cell with subsequent development of industrial companies Hélion and CNIM).

Definition of the current park and the specifications of shuttles under construction

| Current shuttle fleet : 8 shuttles (12 shuttles before ban of wooden boats) |
|---------------------------------|-----------------|
| . No of passengers             | 100 to 160      |
| . Overall length               | 16.5 to 22 m,   |
| . Displacement Depth           | 0.92 to 1.40 m  |
| . Outboard width               | 4.20 to 5.70 m, |
| . Power                        | 2x 215 to 2 x 450 CV |
| . Weight                       | 20 to 32.5 tons |

Specifications of « Inner bay » shuttles

<table>
<thead>
<tr>
<th>Category in relation with inner bay conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>. No de passengers</td>
</tr>
<tr>
<td>. Maximum speed</td>
</tr>
<tr>
<td>. Shell shape</td>
</tr>
<tr>
<td>. Hull material</td>
</tr>
<tr>
<td>. Passenger compartment</td>
</tr>
<tr>
<td>. Comfort</td>
</tr>
<tr>
<td>. Motorisation</td>
</tr>
<tr>
<td>. Consumption</td>
</tr>
<tr>
<td>. Manoeuvrability</td>
</tr>
<tr>
<td>. Approximate cost</td>
</tr>
</tbody>
</table>

Complementary measures

<table>
<thead>
<tr>
<th>Building of new port facilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>. Piano in Toulon</td>
</tr>
<tr>
<td>. Disabled persons accessibility: Necessary ... Floating pontoons/jetties if technically feasible</td>
</tr>
<tr>
<td>. Multimodality</td>
</tr>
</tbody>
</table>

*Development of Transbay transport (bays, channels, rivers): state of the art, success keys factors, passengers Shuttles (current conception and evolutions)*
5.3 Applicable Regulations

Three regulations are applicable within the framework of the French legislation:

. **Clause 223 B**: French regulation issued from successive iterations of previous French national regulations relative to speed boats for passengers transport. Survival of this regulation in the European legislative environment results from difficulties (either technical or economic) for a direct application of the European Directive for small passengers boats.

. **Clause 223 A**: Arising from the transcription of the European directive and with due application for steel hulled construction ships. This text close to Solas is poorly adapted to small units, but its application is necessary since the hull of the ship is steel. The quasi-totality of the small aluminium constructed shuttles or of composite construction is realized in respect for the rule 223B.

. **HSC Code** is a specific international regulation for the high speed vessels. Arising from a new philosophy closer to aviation transport, concerning the characteristics of construction and use of ships, this text was well accepted by many professionals dealing with construction of high speed ships.

Since then, the HSC Code has become more demanding and complex and doing so … it has not been applicable for boats shorter than 25 m in length.

<table>
<thead>
<tr>
<th>Franc-hord</th>
<th>Div. 223 B</th>
<th>Div. 223 A</th>
<th>Code HSC</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Strictement National &lt; 500 ums.</td>
<td>National mais sans douce validité</td>
<td>International</td>
</tr>
<tr>
<td>Origine de la réglementation</td>
<td>Maintien en usage au plan national de l’ancienne réglementation</td>
<td>Transcription Directive 97/70/CE</td>
<td>Code de l’OMI applicable à tous les navires rapides</td>
</tr>
<tr>
<td>Commission</td>
<td>Commission Régionale de Sécurité</td>
<td>Commission Régionale de Sécurité</td>
<td>Commission Centrale de Sécurité</td>
</tr>
<tr>
<td>Catégorie de navigation</td>
<td>3ème, 4ème, 5ème</td>
<td>B : &gt;20 NM de la cote A 221 done SOLAS</td>
<td>Engin de catégorie A ou B</td>
</tr>
<tr>
<td>Type d’exploitation</td>
<td>Navire à passagers</td>
<td>Navire à passagers</td>
<td>Navire à passagers ou Navire Cargo</td>
</tr>
<tr>
<td>Critère d’accès</td>
<td>Matériau coque autre que l’acier et vitesse &lt; 20 nds</td>
<td>Matériau Coque acier et vitesse ≤ 20 nds</td>
<td>Vitesse minimum exigée. Pas de maximum.</td>
</tr>
<tr>
<td>Contrainte sur la vitesse</td>
<td>Vitesse théorique &lt; 20 nds</td>
<td>Vitesse théorique &lt; 20 nds</td>
<td>&gt;20 nds à la WL nominale</td>
</tr>
<tr>
<td>Stabilité à l’état intact</td>
<td>Critères div. 311.1</td>
<td>Résolution A749 : Tassement passagers - P venant en fonction de la hauteur - giration ou critères équivalents</td>
<td>-Tassement des passagers - Vent maxi prévu</td>
</tr>
<tr>
<td>Stabilité après avarie</td>
<td>1 compartiment sans notion de longueur de compartiment</td>
<td>1 compartiment avec breche minimum définie &lt; 450 pax, 2 compartiments au dessus</td>
<td>Multi - compartiments, environ 50% de la longueur du navire envahi</td>
</tr>
</tbody>
</table>

*Development of Transbay transport (bays, channels, rivers): state of the art, success keys factors, passengers Shuttles (current conception and evolutions)*

19
6. Observations upon the market for maritime ferry shuttles

Considering the specificities of the Transbay market, it is interesting to consolidate a data base of knowledge in this niche transport mode.

=> Formalization of the actions of diagnosis
- Analysis of European and French legislation
- Safety standards of passengers ships, freight,
- Standards for harbour facilities,
- Standards for coastal navigation

⇒ Inventory of actors within the sector in France, Europe, the world)
- Naval Architects specialized in passenger boats/shuttles
- Shipyards dedicated to the construction of passengers boats/shuttles
- Ferry operators and operating organisations, national and international
- Organizing Transport Authorities

⇒ Location of manufacturers of infrastructures (pontoons, specialized quays, jetties, platforms)
Specialized research laboratories or entities (such as Créocéan) as well as technical safety and inspection companies (Veritas, Lloyds, CGS)

⇒ Other Data bases
- Current calls for Operating and Maintenance tenders
- Conception and construction of maritime ferries
- Data about passenger demand and use, revenues and operating costs

In the US, Bureau of Transportation Statistics (BTS) conducted a Census of Ferry Operators (230 ferry operators). Data were supplemented by other sources of ferry data, such as the US Coast Guard and the Army Corps of Engineers. The data base contains information on ferry systems, including operators, routes, vessels, and passenger and vehicle boarding. The ferry database is available online – www.bts.gov

References

7. Analyse des sites potentiels d’implantation de pontons d’embarquement, rédaction des cahiers des charges de construction/mise en œuvre de pontons sur les sites retenus – J.M. Beynet (BRL) - 2007

*Development of Transbay transport (bays, channels, rivers): state of the art, success keys factors, passengers Shuttles (current conception and evolutions)*
Annexe 1 : State of the art - solar and fuel cell boats

Solar boats are particularly suitable for tourists and other uses on lakes with low operation speeds and limited passengers loading capacities.

**Solar Boat “Alster Sun” in Hamburg**

Designed by London Solar Lab which is specialised in solar concepts; it is the largest shuttle with solar energy in the world.

The vessel was constructed in 2000 and has a capacity of over 120 persons. Silent and completely autonomous, it emits a rate of 0% CO2. In comparison with a diesel engine with similar energy needs, the Hamburg shuttle saves annually 5 tons of CO2 (carbon dioxide), 10.5 kg of NOx (nitrogen oxide) and 25 kg of SO4 (sulphurous sulphate/acid).

This boat navigates only on the River Elba, with very protected crossings.

<table>
<thead>
<tr>
<th>Length : 43m</th>
<th><strong>Figure 1 – Solar boat in Hamburg</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>V max : 15Km/h (8 Kn)</td>
<td></td>
</tr>
<tr>
<td>Batteries discharge time : 12 h</td>
<td></td>
</tr>
<tr>
<td>Weight in load : 34 T</td>
<td></td>
</tr>
<tr>
<td>Hull construction : stainless steel</td>
<td></td>
</tr>
<tr>
<td>80 batteries kits (2340 A/h – 80V)</td>
<td></td>
</tr>
<tr>
<td>Electric engine : 8Kw (X2)</td>
<td></td>
</tr>
</tbody>
</table>

**Solar Boat « Bécassine » in Geneva**

The electric power for this boat is generated by two roofs alongside the quay equipped with photovoltaic panels (120 m²) which recharge batteries on the boat. The panels on the roof of the ship serve as supplementary power sources.

Batteries situated in the hold feed both electric engines and the trip distance without recharge of the batteries is approximately 90 km to 10 Km (19 kph).

This boat navigates exclusively, on the Lake Geneva, under very protected crossing conditions and is intended for tourist and leisure activities transport.

**Transatlantic Solar boat « Sun 21 » (Ch.)**

It is the very first electric boat to cross the Atlantic Ocean without gasoline (6400 km in 63 days). With 65 m² of solar panels supplying enough energy to allow the catamaran to travel each day up to 198 km. The MW Line launched a commercial model of Sun 21 called C.60. This vessel has a loading capacity of 75 persons.

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“Development of Transbay transport (bays, channels, rivers): state of the art, success keys factors, passengers Shuttles (current conception and evolutions)”
Fuel cell applications for maritime transport (ships)

In Hamburg port, the design of a passenger ship with fuel cell propulsion is developed by the industrial and research partners (Alster-Touristik GmbH, Hysolutions, Proton Motor, Linde AG, GL, University for applied sciences, Czech research and consulting partners). Certification of fuel cell systems for maritime applications will be under control of Germanischer Lloyd AG.

Apache project, financed by the Sea Cluster based in Toulon, also is developing fuel cells technologies for passenger boats, sailing boats and zeppelins.
Annex 2: Abras in Dubai

Abra (Arabic: ابر) is a traditional boat made of wood, used to transport people across Dubai Creek in Dubai, United Arab Emirates. A medium-sized single-engine craft with a capacity of about 20 passengers, it is driven by a single operator from a sort of cockpit stepped in the center of the hull. The short platform around the cockpit, sheltered by a canopy, is where the passengers are seated, all facing outwards 10 on each side. The speed of the engine may be varied, while the steering system is basic: often a wooden rudder connected to the cockpit’s mechanism by means of ropes and pulleys.

Abras used to be the primary means of transportation between the two sides of the creek before cars could cross it via the several bridges or the Al Shindagha Tunnel. It is now mostly used by tourists, local people and sightseers. Yet it remains an essential and frequently-used part of Dubai transportation, ferrying 15 to 20 million passengers annually, and only growing in popularity. It takes under 10 minutes to cross between Deira and the other side of the creek, Bur Dubai. Minor collisions are to be expected as the abras jostle for space, so all passengers must be seated, especially near the crowded docking stations.

The Abra service of today is regulated by the Dubai Roads and Transport Authority. The old boarding piers have been replaced with six official boarding stations and fitted with spacing gates for crowd control; these facilities were built and are maintained by the Dubai Municipality. There are about 149 Abras in service at present. All abras operate from about 5:30am till about midnight, while 10 abras run one of the three routes at all hours. The abras charge a nominal rate (2007) of 1 dirham per direct crossing per head, or 100 dirhams per hour for exclusive hire. "Rowing" abras are also available at 1 dirham per head or 30 dirhams per hour.

The fees and capacity are also regulated by the public transport authority, and the abra operators are issued permits by the RTA to grant them the license to operate within the law. The authorities are currently considering an increase in the traditionally accepted fare, and a switch to eco-friendly CNG fuel or even solar energy.
Abras are a part of the traditional creekscape of Dubai, and are considered a part of the city’s heritage. In January, as a part of the Dubai Shopping Festival, an abra race is run on the creek with a 6,000 dirham first prize.

Abras cross the creek round the clock (including between midnight and 5 am) and a trip on an abra is a must for every visitor to Dubai.