

# Delivering Charging & Technology Solutions —Tackling Congestion

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*Principal*

**Brisbane, Queensland**  
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1. Outline Demand Management
2. Look at :
  - Singapore
  - London
  - Italy
  - Stockholm
3. Compare & Contrast
4. Lessons Learnt

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## Supply based solutions to congestion

- The traditional transport planning model has been *'predict and provide'*. This has led to a haphazard and generally eclectic supply of infrastructure in geographic areas, both in terms of roads and public transport.
- Congestion has been seen historically as inadequate supply of road capacity and construction being inadequate rather than demand being excessive or poorly managed.
- Solutions to road congestion have traditionally been supply based:
  - Construction of road capacity — primarily for private cars;
  - Construction of alternative modes — public transport;
  - Installation of ITS for traffic management — more efficient road capacity usage.

*"...congestion is costing America an estimated \$200 billion a year. Yet many accept the fact that Americans squander 3.7 billion hours and 2.3 billion gallons of fuel each year sitting in traffic jams..."*  
THE HONORABLE NORMAN Y. MINETA  
FORMER US SECRETARY OF TRANSPORTATION



## Mixed outcomes

- Building roads provides immediate relief, and sometimes provides a sustainable solution unless:
  - Bottlenecks further along network are impractical/too expensive to relieve;
  - New capacity encourages growth in area it serves, so demand matches and later exceeds capacity;
  - New capacity improves competitiveness of peak car commuting over public transport encouraging mode shift to private car usage
- Virtually impossible to build in advance of congestion due to cost, limits of funding, urban highway construction timelines and sheer practicality (buildings, other networks, open space vs. roads) unless zoning and zoning restrictions are maintained over the long term horizon.
- Building new public transport may make a modest difference to mode shares, and may stem growth in car traffic, but can have much spare capacity, especially off-peak.
- Traffic management/ITS systems can be invaluable in responding to incident based congestion, and getting more efficient use of the network, but these efficiencies tend to provide extra capacity to manage growth in demand, rather than provide a solution.

***Traffic congestion is typically 50% — 50% :  
50% is the result of accidents / incidents and  
50% is due to insufficient supply for the demand.***

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## Demand management to relieve congestion

- Demand management has been a more recent policy development in handling congestion. This can be separated into non-pricing and price based demand management.
- Non-pricing demand management includes:
  - Ownership restriction;
  - Marketing of alternatives;
  - Parking restrictions;
  - Planning regulations (limits on parking, location of business/residential);
  - Travel planning including individual travel planning;
  - Public transit innovation (park and ride, integrated ticketing, real time information systems);
  - Telecommuting, flex-time;
  - HOV lanes; and
  - Infrastructure, urban planning to improve convenience/safety for cycling, walking, access to public transit.
- Price based demand management includes both traditional and non-traditional forms of pricing land transport modes.

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## Traditional price based demand management

- **Taxes on vehicle ownership** (Used in Singapore, Hong Kong, Denmark). Effectively delays vehicle ownership for people on lowest incomes, but does not influence usage except at the margins (higher taxes on high emission vehicles, low or zero tax on low/no emission vehicles).
- **Taxes on fuel consumption** (Used worldwide, but used for managing congestion in the UK). Elasticity of demand for fuel is low, in UK estimated to suppress about 10% of trips that would otherwise have occurred. Penalises users of rural and uncongested roads around as much as those on congested roads.
- **Taxes on parking** (Widely used). Can impact mode shares for certain commuter groups, but can be administratively complex and expensive, risk to retail traffic and decentralisation of business to secondary centres.
- **Subsidies on public transit fares** (Widely used). Has impact on mode share, but also subsidises those who would use transit regardless, can result in major peaks of demand and reduces incentives to more flexible employment.).
- **Toll roads** (Widely used to finance new infrastructure). Mature toll roads/facilities can use variable pricing to manage demand to maximise revenue and spread peak traffic periods.
- **HOT lanes** Adds new "paid priority lanes" and relieves some traffic in free, congested lanes, but keeps people in their cars and deposits both into the urban centre when priority lanes stop. Does not directly cause modal shift.

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## Road pricing to manage congestion

- Road Pricing has been implemented in:
  - Singapore;
  - Durham;
  - London; and
  - Stockholm.

Note: Norway has implemented cordon pricing for revenue generation to fund transport investment in Bergin, Trondheim and Oslo.
- Italy has also implemented access control to manage congestion through a permit system for inner city zone access (and exemptions for residents, nominated customers of businesses or users of medical facilities). Currently operating in 8 cities – Rome, Florence, Bologna, Siena, Pisa, Torino, Perugia and Mantua. It is being studied in Milan, Naples, Padua and several other cities.
- It has been studied in New York City on a *pro bono* basis by a consortia of companies, which Booz Allen assisted in the evaluation criteria, business impacts and international experience.
- Other US Cities/Toll Roads have employed other schemes – variable pricing on toll roads and HOT lanes.

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## Road Pricing Dimensions



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# Strategic Goals and Objectives

- Need to define problem (what is congestion?), location, time, trip patterns, demographic of road users, economic growth levels/locations, infrastructure limitations, mode shares, budgetary levels.
- Define desired outcomes:
  - Relief of congestion (where, when, to what degree);
  - Generation of revenue (how much, for what purpose).
- Longer term strategic goals consistent with pricing:
  - Broader pricing initiatives;
  - Other ITS initiatives;
  - Urban form changes.
- Roles of pricing, non-pricing demand management, variable tolling, public transit, parking and road construction/management
- Use of revenue ( build infrastructure, public transit, urban public space, parking facilities, bike/walking paths, green space, and reduce other taxes)

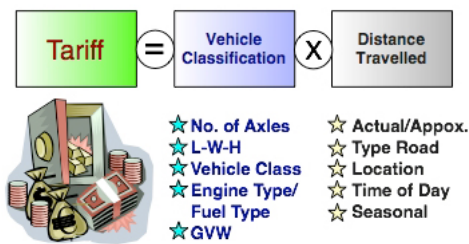
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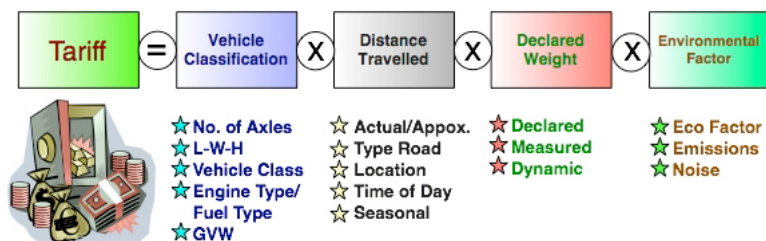
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# Current and Future Pricing Options

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## Key strategic components

- Times of charging (24/7, Monday to Saturday, weekday all day, commuter peaks).
- Location of charging (geography, direction of flow).
- Vehicles to be charged/exempt (cars, buses, trucks, taxis, motorcycles).
- Basis of charge (time, location, vehicle type, pavement impact, seasonal, spatial).
- Type of scheme:
  - Cordon (Singapore, Stockholm);
  - Area (London);
  - Strategic network (Germany, Austria, Sydney);
  - Full Network/distance (Switzerland, New Zealand);
  - Zone access control (Italy).
- Use of net revenue (fund roads, fund public transport, revenue neutral/tax recycling);
- Alternatives (change trip time, public transport, bypass routes, telecommuting)
- Exemptions/discounts for other policy objectives.

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## Singapore ALS

- **Paper licence based entry permit scheme**
- **1975 to 1998**
- **Scheme adjusted 14 times**
- **Significant impacts**
- **Suppression of Demand by 18%**
- **AM peak inbound car flows approx half of pre-scheme flows**
- **Journey to work by PT 33% in 1974; up to 67% in 1996**



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## Singapore ERP

- Introduced in 1999
- Replaced paper ALS scheme and adjusted area
- DSRC with bank issued “smart card”
- 17% to 24% AM peak reduction into charged area and 14.6% over whole day
- Charges adjusted per access route
- Monitoring and adjustment based on average speed every 6 months



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## The Goal: “User Pays” Principle

**The pay-as-you-use principle of ERP makes motorists more aware of the true cost of driving. This way, road usage can be optimised.**

- Charges are levied on a per-pass basis and rates are set based on traffic conditions at the pricing points.
- A motorist is encouraged to decide whether to drive, when to drive and where to drive.
- He may choose a different route, mode of transport, time of travel, or not travel at all.
- Those who choose to pay and stay on the road will enjoy a smoother ride.

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# Singapore ERP

**RESTRICTED ZONE A**

- 1. Serangoon Road
- 2. Queen Street
- 3. Victoria Street
- 4. North Bridge Road
- 5. Beach Road
- 6. Tanjong Pagar Road
- 7. Republic Boulevard
- 8. Havelock Road
- 9. Cross Street

**RESTRICTED ZONE B**

- 10. Bras Basah Road
- 11. Tanjong Pagar Road
- 12. Lim Tock Koh Road
- 13. Telok Ayer Staircase
- 14. Bras Basah Road
- 15. Bras Basah Road (CTE) / Havelock Road
- 16. Bras Basah Road
- 17. Bras Basah Road (CTE) / Bras Basah Road
- 18. Bras Basah Road
- 19. Bras Basah Road

**RESTRICTED ZONE C**

- 20. Bras Basah Road
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**ERP GANTRY**

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# Singapore ERP

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**ERP GANTRY**

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## Singapore ERP

### PUBLIC TRANSPORT CAPACITY

	1994	2004
Average Bus Fleet and Routes in Operation		
Average Bus Fleet Operated	2,549	3,140
Number of Bus Routes in Operation	231	260
Average Daily Vehicle-Kilometres Travelled		
MRT ('000 train-km)	25.0	40.7
Bus ('000 bus-km)	-	819.4

### PUBLIC TRANSPORT UTILISATION

	1994	2004
<sup>(a)</sup> Average Daily Ridership ('000 passenger-trips)		
MRT	709	1,276
LRT	-	57
Bus	2,920	2,788
Taxi	826	876

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## Singapore ERP Benefits

### Fair

- Charges are based on usage so those who contribute more to the congestion pay more. Those who use the roads less frequently or who travel during non-ERP hours will pay less or not need to pay at all.

### Convenient

- Motorists need not purchase daily/monthly licences.

### Reliable

- As a fully automated system, there is no risk of human error as human enforcement is not required.

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# London Congestion Charging



## **Mayor's Transport Priorities**

**Primary aim to answer four of Mayor's ten transport priorities:**

- To reduce congestion
- To make radical improvements in bus service
- To improve journey time reliability
- To make the distribution of goods and services more reliable, sustainable and efficient.

**Additionally:**

- ✓ To generate net revenue to improve transport

## Where is the Congestion Charging zone?



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## Overview

- Introduced in February 2003;
- Congestion charge was a £5 daily charge for all vehicles (2003-2005); Currently £8 per day;
- Operates Monday to Friday excluding weekends and public holidays;
- Applies to all vehicles driving or parking on public roads within the CC zone;
- Taxis, motorcycles and buses have 100% discount (exempt); and
- CC zone residents receive a 90% discount and disabled "blue badge" holders are eligible for 100% discount.

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## Operations Infrastructure



TfL Hub Site

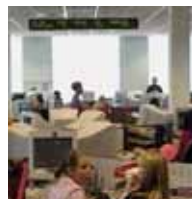


On and inside  
Inner Ring Road  
London

Cameras



Data Centre



Call Centre

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## Purchasing the Congestion Charge



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## Western Expansion



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## DSRC Technology Trial



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## Benefits

1. Private Car Usage decreased ~ 26%; Overall ~ 16%;
2. Bus Ridership increased 14%;
3. Bus Service times improved ~ 16% to 22%;
4. Cycling up 43%;
5. Air Quality improvement;
6. Safety Improved - Accidents & Incidents down; and,
7. Neutral effect on business in area.

## London CC Results

### Mayor of London Ken Livingstone said:

"Congestion charging was a radical solution to a long standing problem. It has helped to get London moving again after years of choking traffic. London has become the first of the great world cities to set about substantially reducing congestion in the central area."

"Latest studies show that more than two thirds of Londoners now say that the scheme is effective in reducing congestion and nearly twice as many people support the scheme as oppose it."

"The success of this scheme means that the heart of our Capital is now a better place to work and to visit."

## Italy

- DSRC based with Autostrade “TELEPASS” transponders.
- Rome has DSRC tag access for PROGRESS Project testing.
- Florence implemented DSRC access control in November 2003.
- Torino progressing study for VPS based system and settled on DSRC (2005).
- Other cities following Florence -  
Bologna (2003), Siena (2004), Pisa (2005), Perugia (2006), Mantua, Padua, Naples, Ciuuso, Trieste.



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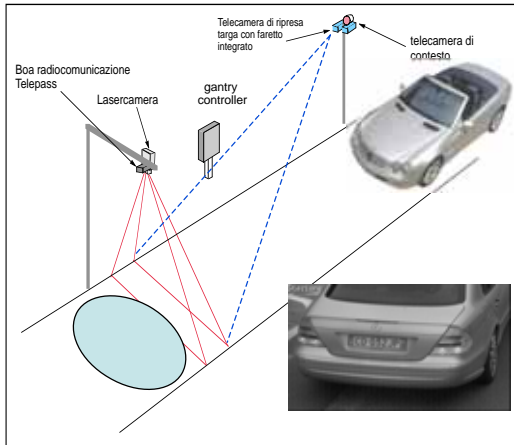
## *Electronic Gateway & OBU*



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## Integrated Telepass + OCR technology



**Stand-by gantry:** in absence of transits the beacon is turned off

**Activation of Telepass:** when laser camera detects approaching car, system is activated

**No Telepass:** if transiting car has no Telepass on-board unit, system takes pictures of the license plate

**Control of vehicle data:**

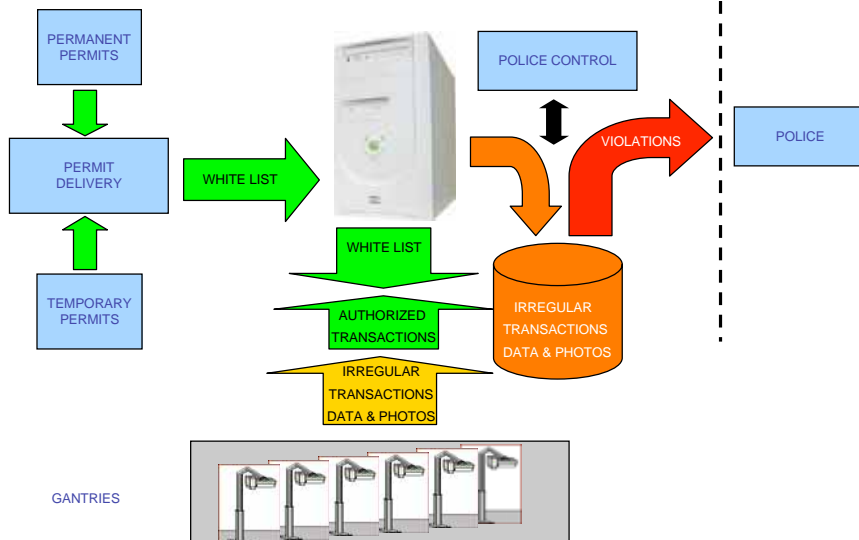
**Vehicle found in white list:** data / picture is cancelled

**Vehicle not found in white list:** fine procedure is activated

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## DATA FLOW



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## Florence Zonal Access Scheme



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## Florence Access Management

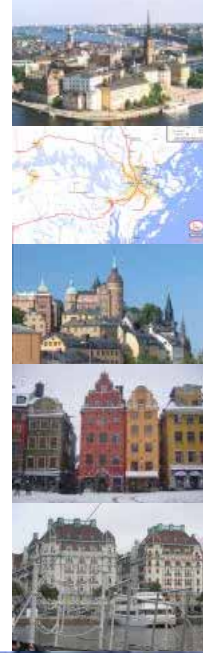


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## Stockholm Congestion Charging Trial

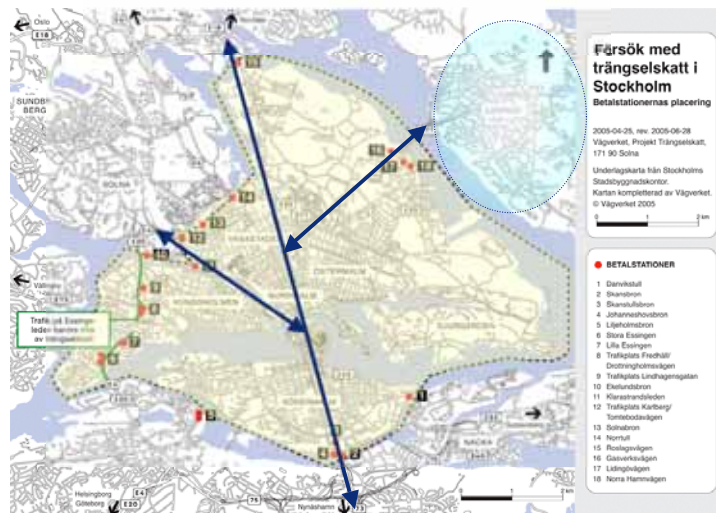
- Trial of Congestion Charging in Stockholm;
- Full scale test from Jan '06 to July '06;
- Public Referendum in September 2006;
- Monday to Friday, 06:30 to 18:30 hrs;
- Charges per crossing; for private car range from US\$ 1.37 to \$2.75 per crossing with daily cap of \$8.25 maximum per day;
- Results Encouraging:
  - Initially 25% decrease in demand - now down to 22%;
  - Business slightly improved;
  - Survey data - 62% approve of scheme.



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## Stockholm CC Area



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## Stockholm Gantries



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## USA - Future Direction

*We have the tools, the technology, and the plan to make today's congestion a thing of the past."*

**THE HONORABLE NORMAN Y. MINETA**  
*Former US Secretary of Transportation*

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## Comparison of road pricing systems

	Singapore	London	Italy	Stockholm
Time of operation	0730-1000, 1200-1900 weekdays and 1200 -1800 Saturdays.	0700-1830 weekdays (1800 with western extension)	(Rome, example only) 0630-1830 Monday to Friday, 1400-1800 Saturday	0630-1830 Monday to Friday
Vehicles charged	All	Cars, trucks	All (fined if not permitted)	Cars, taxis, minibuses, trucks
Basis of charge	Time, location, vehicle type (space) according to congestion	US \$ 15 flat	Fine for no permission to enter.	Time according to congestion.
Range of charge (car)	US \$ 0.32 to US \$ 1.60 per crossing	US \$ 15 per day (US \$ 1.50 per for residents)	Permit only 1 to 3 day pass (maximum) US \$ 12.87 per day	US \$ 1.37 — US \$ 2.75 per crossing maximum US \$ 8.25 per day
Type of scheme	Cordon / SRN	Area	Zone permit	Cordon with Free Bypass Route

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## Comparison of road pricing systems

	Singapore	London	Italy	Stockholm
Exemptions / discounts	Emergency vehicles	Buses, taxis/minicabs, emergency vehicles, motorcycles exempt (and certain operational vehicles of boroughs, port, armed forces, breakdown services). Residents' cars, alternative fuel cars and disabled persons' cars discounted 90%	Entry granted to residents and registered businesses, emergency vehicles. Non-residents granted access by businesses, medical facilities on day pass basis or can purchase day-pass (up to 3 days maximum)	Emergency vehicles, buses, disabled, military, alternative fuel, motorcycles, foreign, residents of Lidingo Island
Use of Net Revenue	State revenue, offset vehicle ownership taxes	Improvements to buses, cycling, road maintenance	Modest surplus	Improvements to public transport
Through traffic options	None, roads around cordon	Ring road around area (two through routes with Western Extension)	Ring road around zone in all cases	Freeway through cordon
Future plans	Three new charging zones, State-wide, distance based GPS	Double size of area (Western Extension), DSRC technology, increase charge by 25%	Pricing Several new Cities	Referendum on future of trial. Note: 62% approval rating suggested by survey data (03/06)

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## Comparison of road pricing systems

	Singapore	London	Italy	Stockholm
Demand Management/ traffic impacts	20% increase in traffic speed; effective in maintaining an optimal speed range of 45 to 65 km/h for expressways and 20 to 30 km/h for arterial roads.	18% reduction in traffic	20% - 24% reduction in traffic	23% reduction in traffic (March 2006)
Business Impacts	No Impact	Neutral	No Impact	Slight Improvement in GDP of Local Area
Enforcement/ detection of vehicles (estimated)	99.7% accuracy	-70% accuracy	99.95% accuracy	99% accuracy
Type of technology	Dedicated Short Range Communications (DSRC) with Bank Issued Smart Card and image capture.	Image capture (Automatic Number Plate Recognition, ANPR)	Dedicated Short Range Communications (DSRC) and image capture	Dedicated Short Range Communications (DSRC) and image capture
Financial outcomes: cost/revenues	US \$ 52 m gross revenue – O&M 20% costs	US \$ 352m gross revenue – O&M 46% costs	Cost recovery (regulatory system) – O&M - 5% costs	Trial only - Estimated US \$ 550 K gross per weekday – O&M N/A

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## Lessons Learnt

- Establish Policy and Legislative framework FIRST — THEN select a solution to fit Policy objectives;
- Understand, refine and test your objectives, BE OPEN and COMMUNICATE Clearly;
- Package should include supply and demand management (pricing and non-pricing) components;
- Objectives drive the technology selection not the other way around;
- Pricing is part of the package — establish choices in payment streams – ensure simplicity and efficiency;
- Robust enforcement / legal appeals process;
- Minimise exemptions & consider discounts
- Clearly define what will be done with the revenues and,
- **POLITICAL WILL** is essential!

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## Lessons Learnt

*“Congestion is not a scientific mystery, nor is it an uncontrollable force. Congestion results from poor policy choices and a failure to separate solutions that are effective from those that are not. But we don’t have to let traffic delays put our lives on hold any longer.*

**THE HONORABLE NORMAN Y. MINETA**  
*Former US Secretary of Transportation*

***But do we have the Political Will?***