Dunedin Peak Oil Vulnerability Study and Strategic Transition Plan

New Methods to Investigate Peak Oil Risks, Adaptation and Mitigation

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IPENZ TG Conference *20 March 2012* *Rotorua*

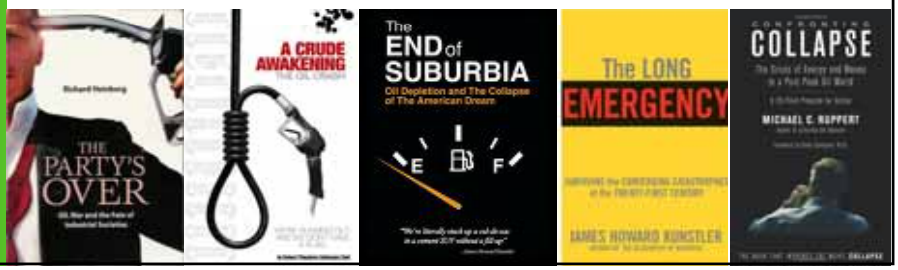
Dunedin Peak Oil Vulnerability

July - Dec 2010 EAST Research Consultants Ltd.

Krumdieck, Rendall, Watcharasukarn, Page

Peak Oil Issue

Even if you believed it was an issue, what would you *do* about it?

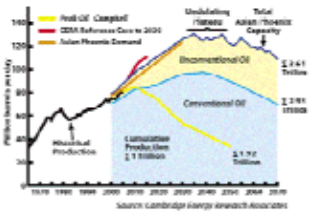


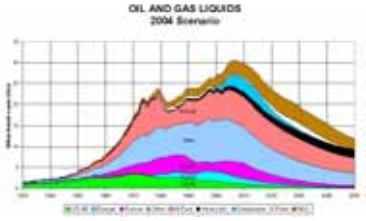
Stand and Deliver

- Understand Oil Supply as a Planning and Management Issue
- Assess Risks to Essential Activities & Goods
- Quantify Adaptation over Planning Time-Frames
- Strategic Transition Analysis, Design, and Re-Development

Peak Oil: Understanding the Issue

- Facts are Clear
- **Probability and Time Frame**

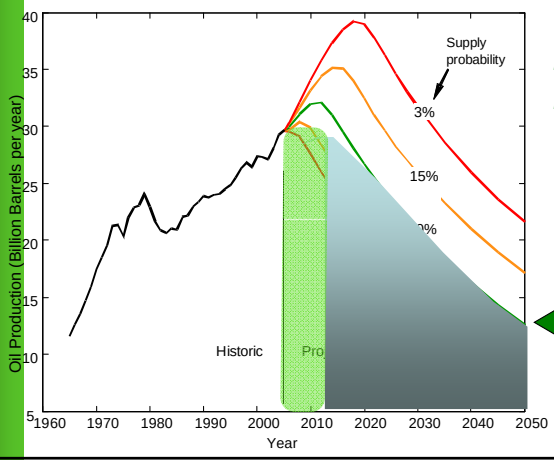




(Campbell, 2004)

Long Range Planning Issue

Meta Analysis of petroleum geology experts



Raleigh Distribution
Monte-Carlo Simulation

50% Reduction by 2050

(Dantas *et al.*, *2007*, NZTA 311)
(Krumdieck, *et al.* 2010, *Trans Res A*)

Impact Depends on Adaptation

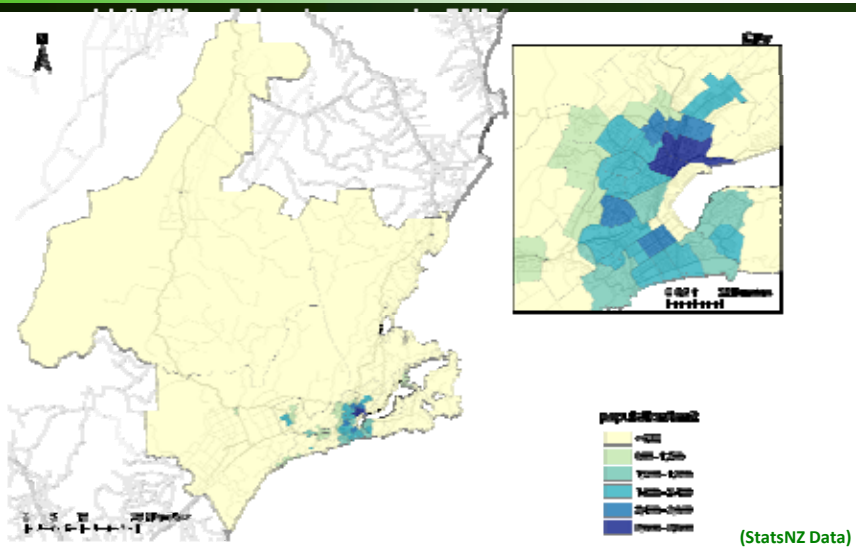
- How do activity systems currently depend on fuel?
- What is the Adaptive Capacity?

Current Energy Use For Current Travel Demand

Change in Oil Supply

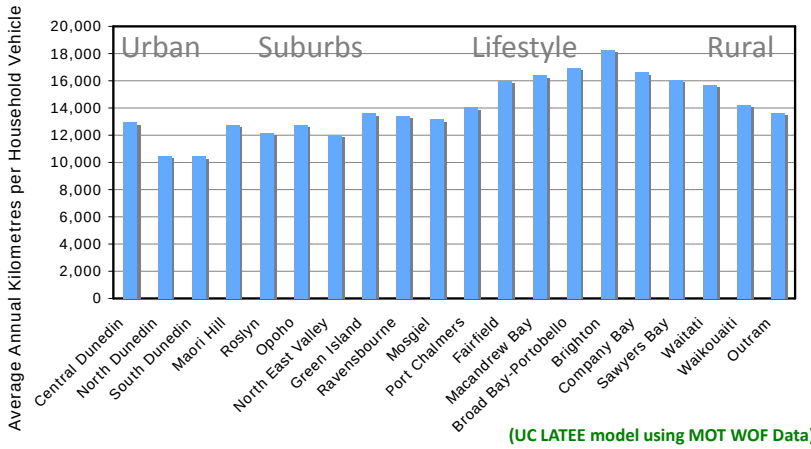
Future Energy Use For Future Travel Demand

Population - Origins & Destinations



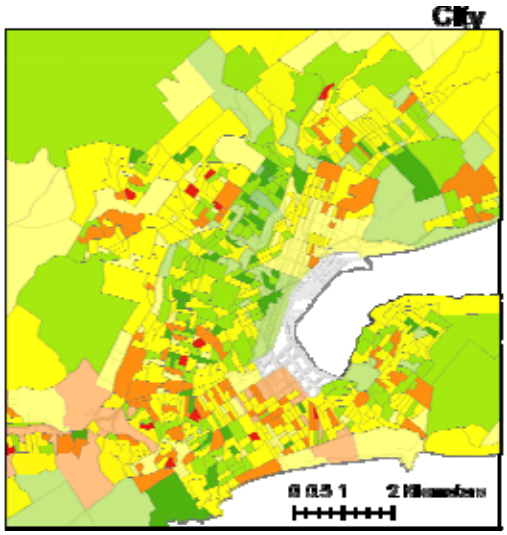
VKT Demand Audit

- Annual Vehicle Kilometers Traveled



(UC LATEE model using MOT WOF Data)

Affordability



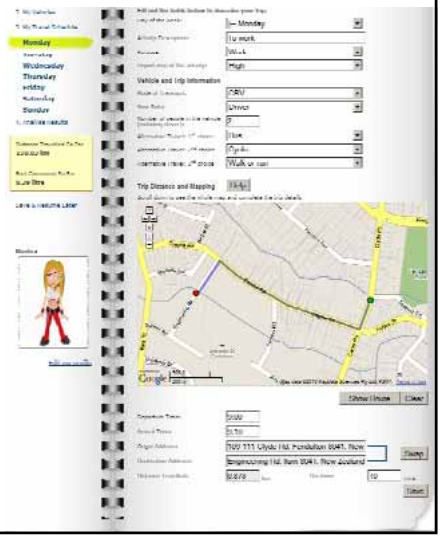
- *Car Ownership*
- *Household Income*
- *Drive to Work*

High Vulnerability
Less Vulnerable
Low Vulnerability

VIPER (Dodson & Sipe, 2005) analysis using Census Data

Travel Adaptive Capacity Survey

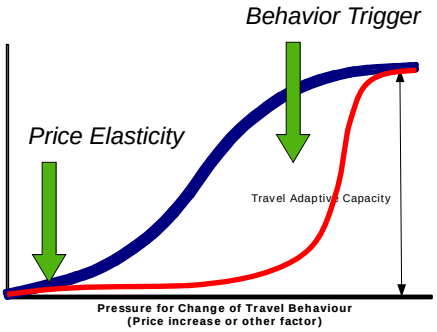
- Monday
- Work
- Drive CRV
- Home to Uni
- If you couldn't take your car, how many other ways do you have?
  - Walk
  - Bike
  - Bus



(Krumdieck, Page, Watcharasukarn, 2012, NZTA Research Report)

Adaptive Capacity Assessment

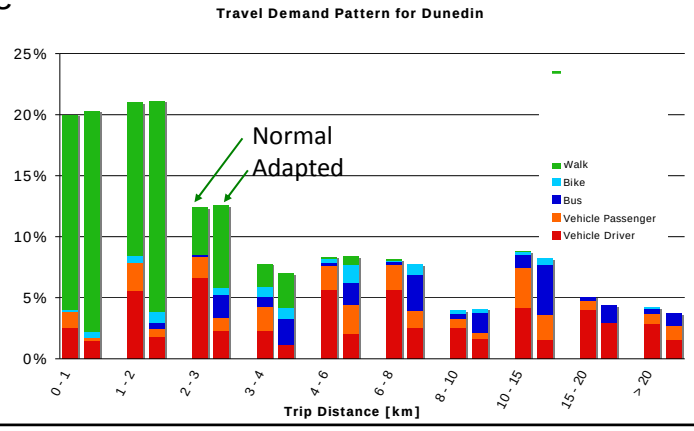
- TACA Survey



(Watcharasukarn *et al.*, 2011, *Trans Res A*)

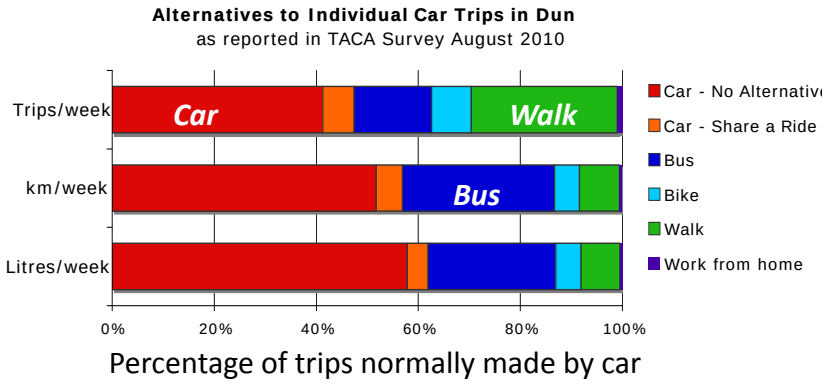
Adaptability in Travel Demand

- Number of Trips
- Distance
- Mode

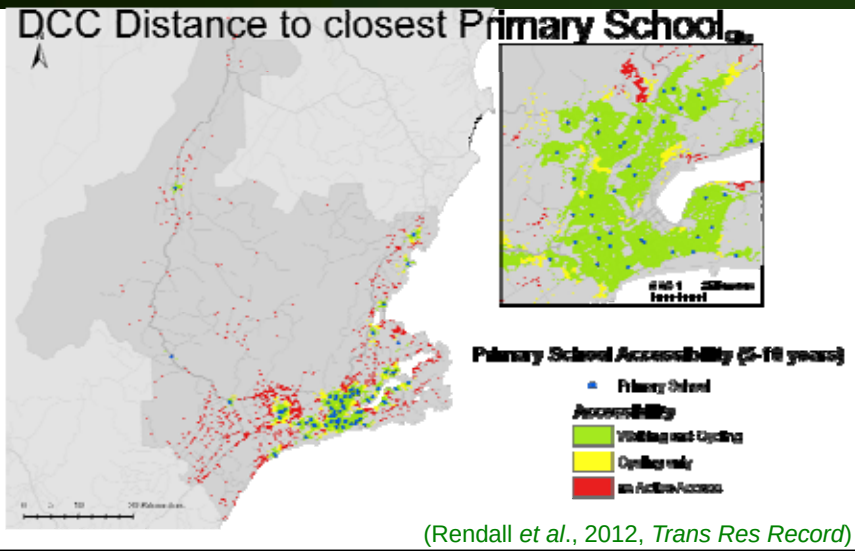


Travel Adaptive Capacity

- Dunedin could reduce fuel use by 40% and not lose access to activities!

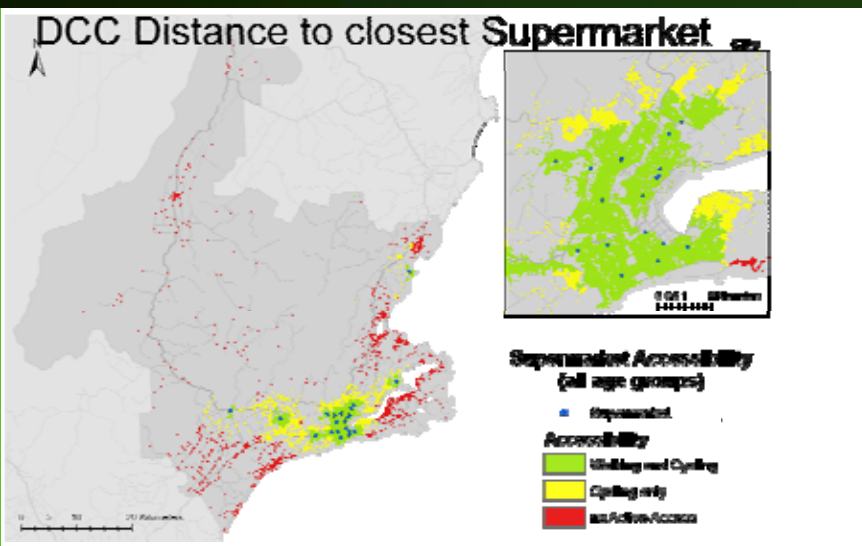


Active Mode Accessibility



(Rendall *et al*., 2012, *Trans Res Record*)

Active Mode Accessibility



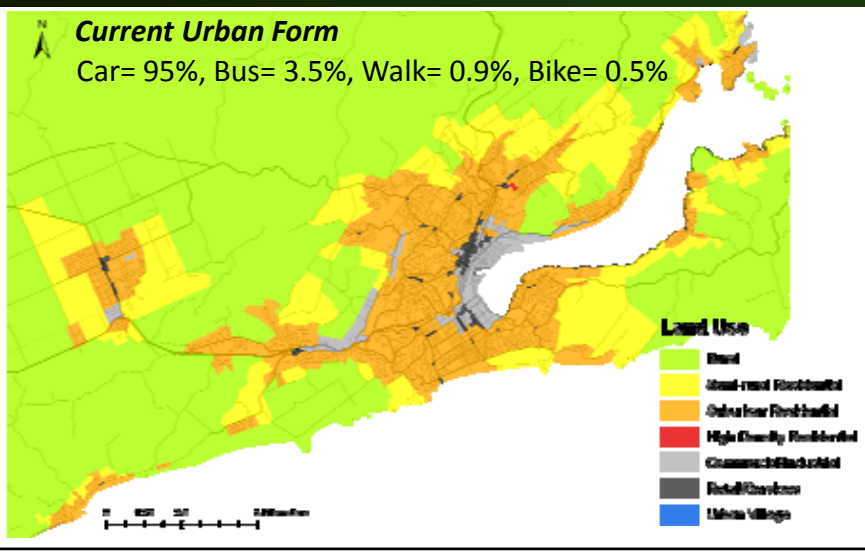
Development Scenarios

- Urban Form Developments
- Technology Developments
- Behaviour Developments

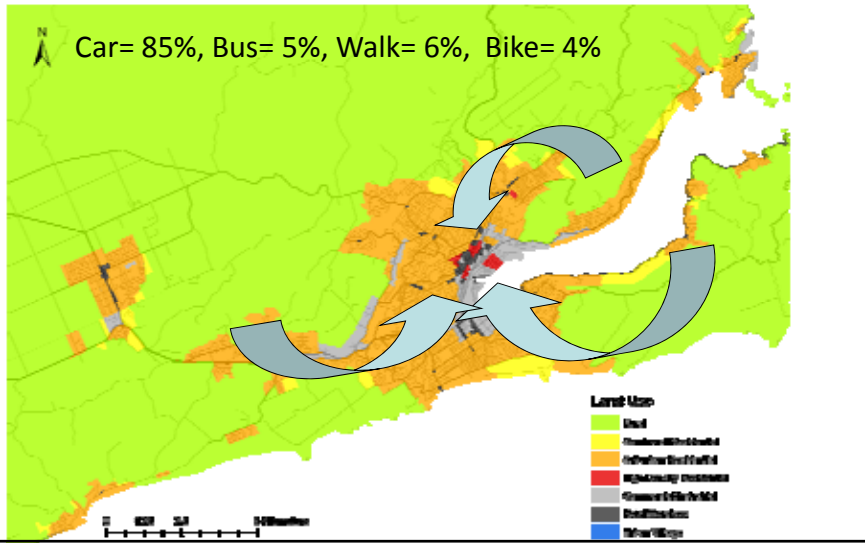
Alternatives

- Biofuels: 50% of petrol replaced
- Electric Cars: 50% of vehicles replaced

Current Urban Form: No Change

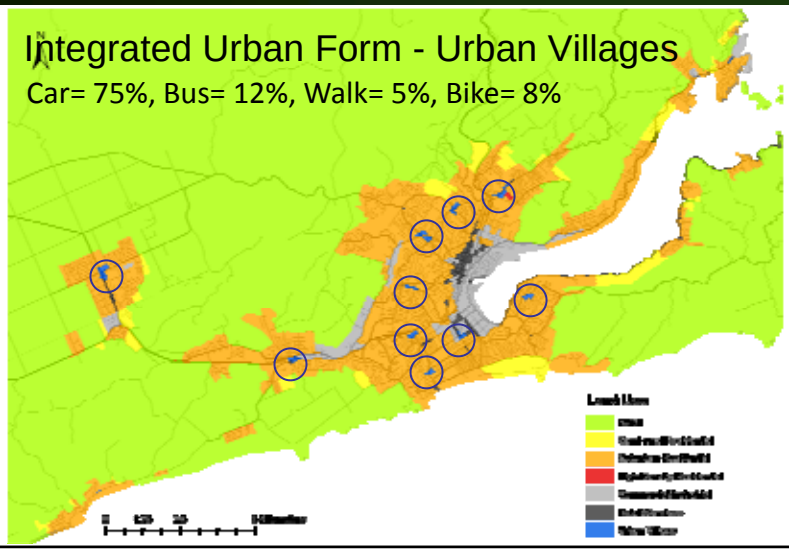


Dense Urban Form



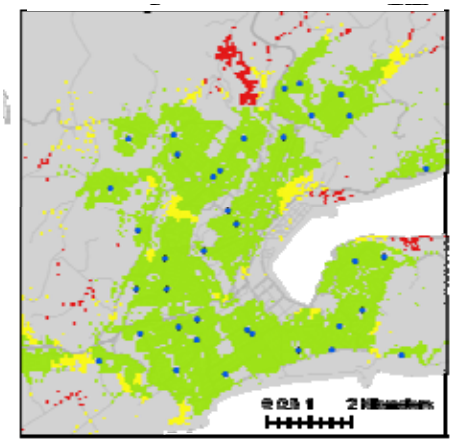
Development Scenario

- Integrated Urban Form - Urban Villages
  Car= 75%, Bus= 12%, Walk= 5%, Bike= 8%



Development Scenario: Active Mode

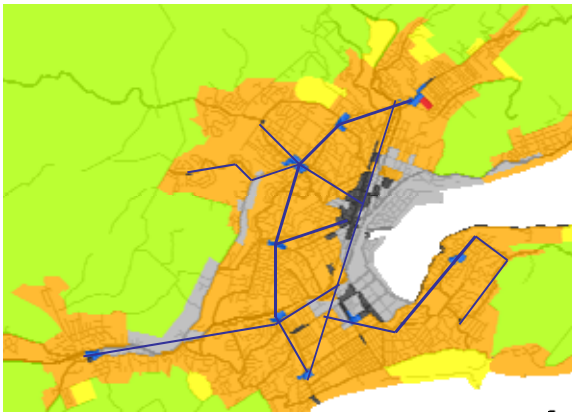
- 100 km Bike Ways



All children under 12 can get to their school by walking or by bike without being at risk from cars or trucks.

Development Scenarios: Public Transport

- 50 km of Electric Trolleybus



Village Centres, CBD, Schools connected.

Development Scenarios: Vehicle Turnover and Reduction

- High Efficiency Vehicles

2 litres/100km

4.5 litres/100km

11 litres/100km

17 litres/100km

Fleet Efficiency = 5 l/100k

1 car +1 scooter per household

Development Scenarios: Behaviour Adaptation

- "Low-Carbon Lifestyle"

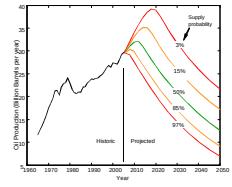
Vehicle = 25%
Bus = 35%
Walk= 30%
Bike = 10%

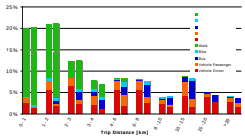
Bill Campbell ODT

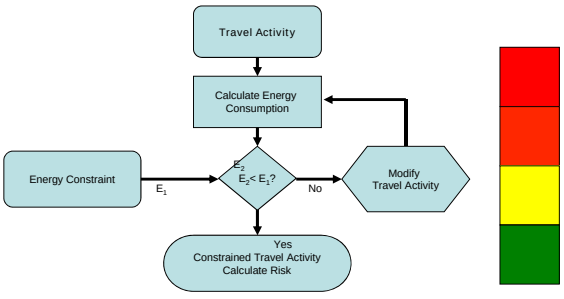
High Efficiency Vehicles and Scooters

Risk to Essential Transport Activities

RECATS Method







$$R_e = P_e\left\{\frac{\sum_m\sum_d\sum_s T^{m,d,s}\cdot IW^s}{\sum_m\sum_d\sum_s T^{m,d,s}\cdot IW^s-\left(N_{ms}+N_{ds}+N_{tc}\right)-\sum_m\sum_d\sum_s D^{m,d,s}\cdot IW^s}-1\right\}$$

(Dantas et al, 2008, *JEAST;* NZTA Report)

Strategic Analysis to 2050

Fuel, Vehicle, Behaviour Adaptations	Urban Form Adaptations: Active Infrastructure (100km Bikeways)	Dense City Centre	Integrated Urban Villages	Current Urban Form
3 L/100km Fleet Efficiency	Possible	Possible	Possible	Unlikely
50% Biofuels Synfuels	No	No	No	No
50% Electric Vehicles	No	No	Unlikely *golf carts only*	No
50 km of Electric Trolleys	Possible	Possible	Possible	Unlikely
Low Carbon Lifestyle	Yes	Yes	Yes	Possible

Urban Form Changes + Alternatives Efficiency Improvements

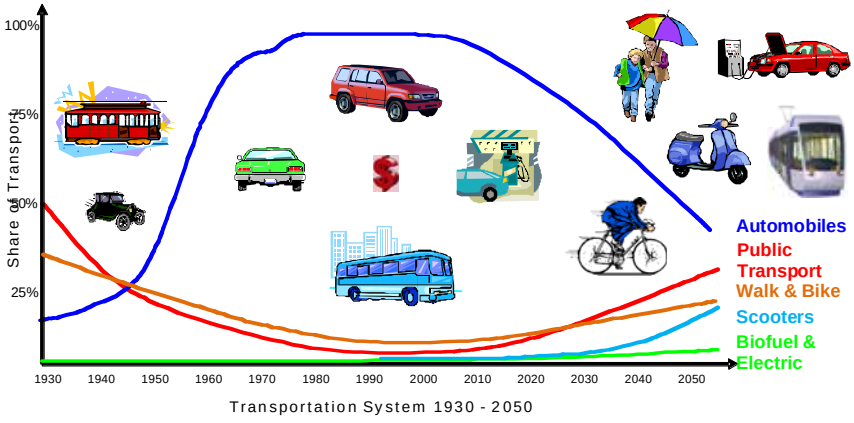
Not available
High cost
Not feasible

High Risk of Doing Nothing

Urban Form Changes + Behaviour Changes

Strategic Analysis ➡ Opportunities

Conclusion: There are no solutions, only choices



Transportation System 1930 - 2050

Thank you for your attention

Engineering Research to Investigate and Mitigate Peak Oil Risks

Dr. Susan Krumdieck

Presentation to Walloon Parliament 26 April 2011 Namur, Belgium

Dense Urban Centre

- 50% Reduction in Commuting over 10 km
- Loft Apartments
- Pedestrian Zones
- Amenity Apartments
- Culture, Arts

Integrated Urban Villages

- Village Centres: Shopping, Medical
- Activity Areas
- Weekend Markets
- 30% local business growth