technology + demographics + transportation
first commercial microprocessor chip - 2,300 transistors
skylake chip - 1.75 billion transistors
500,000 would fit on a single 4004 transistor
deliver 400,000 x the computing muscle
if cars progressed at the same rate, the fastest would travel at 67,061,662 miles per hour
the tallest building would now reach half way to the moon
transportation disruption
three **disruptors**

**ride sharing**

**autonomous vehicles**

**electric vehicles**
impact on public transportation operations mode costs parking facilities vehicle ownership vehicle trips miles travelled level of service
Uber investing $500 million to not use Google maps valued at $9 billion. They don’t own anything, a taxi licence is now worth nothing. Transportation disruption.
autonomous vehicles + ride share

may reduce the number of cars needed
may reduce or increase the number of parking spaces
may reduce costs so much transit riders shift = future gridlock

gas price + vehicle trips - DC when gas hit $6
what is transportation about
US traffic delays = 3 billion gl of fuel
7 bi hours in a car
cost = $160 bi - $960 | commuter

US public transportation trips 2016 - 10.2 billion
1990  5,740,648 bus riders (not brt)
2016  4,945,927

interstate highway
housing subsidy
transit & climate change

net reduction in ghg - takes vehicles off the road
increasing frequency
vehicle loads
operating hours
all reduces ghg
reduces congestion idling
alternate fuels
calgary transit - renewable energy
transit should spur economic growth enhance environmental conditions build social equity
useful transit

all purpose riders
frequency | travel time | destination
walkable | connected
density
multimodal
weather protection
useful transit - designed for all purpose riders

occasional - once in awhile
commuters - 2 x daily | 5 days wk
all purpose
work | shopping | entertainment | errands
regular part of their routine

ride for multiple purposes & in off peak hours
useful transit - frequency | travel time | destination

**dedicated right of way**
**signal priority**
**prepaid fare cards**
**direct routes**
**mobile apps**
Where do downtown workers live?

- Within 2km: 14%
- 2.1 to 5km: 17%
- 5.1 to 10km: 27%
- 10.1 to 15km: 26%
- Over 15km: 16%
useful transit - designed for **all purpose** riders

do **not** design for the peak service

peak only service increases costs for transit

union agreements split peak service
all purpose riders

87% of transit riders is jobs & consumers
49% to & from work
21% shopping trips
17% recreational
useful transit - walkable | connected

to home
work
retail
services
entertainment
useful transit - **walkable** | **connected**

multimodal
useful transit - **walkable | connected**

to home
work
retail
services
entertainment
useful transit - **density**

= walkable | connected

generates - **ridership**

**property tax**

land use
Revenue - Calgary

Inner city density pays

Average Tax Yield per Acre by Property Type
Tax Year: 2015

- Farmland: $230
- Multi-Family Low Rise: $8,232
- Single Family Detached: $11,373
- Industrial: $14,363
- Single Family Attached: $17,162
- Retail: $36,617
- Office: $61,126
- Multi-Family High Rise: $76,017
- Multi-Family High Rise Mix: $112,430
- Downtown Office High Rise Mix: $1,510,038

Total: $1,510,038
useful transit - density

don’t wait
useful transit - **density**

don’t wait
useful transit - multimodal

walk | run
bike
carpool
bus | local | brt
slugging
rail
useful transit - multimodal

walk | run
bike
carpool
bus | local | brt
slugging
rail

“Spontaneous carpooling: Calgary’s planning chief suggests hitch hiking as a grassroots solution to city’s gridlock”
what is transportation about demographics?
<table>
<thead>
<tr>
<th>the user</th>
<th>age</th>
<th>education</th>
<th>income</th>
</tr>
</thead>
<tbody>
<tr>
<td>ethnicity</td>
<td></td>
<td>health</td>
<td>land use</td>
</tr>
<tr>
<td>employment</td>
<td></td>
<td>infrastructure</td>
<td>access</td>
</tr>
</tbody>
</table>
median age

- Madison, WI: 30.9
- Stockton, CA: 31.3
- Lincoln, NE: 32.2
- Anchorage, AK: 32.5
- Buffalo, NY: 33.1
- Glendale, AZ: 33.4
- Ft. Wayne, IN: 34.7
- Birmingham, AL: 35.7
- Boise, ID: 35.9
- St. Petersburg, FL: 42.2
% of seniors to working aged adults

- Anchorage, AK: 12.8%
- Madison, WI: 14.4%
- Glendale, AZ: 16%
- Lincoln, NE: 17.8%
- Buffalo, NY: 18.1%
- Stockton, CA: 18.3%
- Boise, ID: 18.7%
- Birmingham, AL: 19.5%
- Ft. Wayne, IN: 20.9%
- St. Petersburg, FL: 25.7%
% of working aged adults to seniors - calgary

50 % increase in total population by 2039

202 % increase in seniors population

58% drop in working aged adults to seniors in 33 yrs

<table>
<thead>
<tr>
<th>Year</th>
<th>Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>6.1</td>
</tr>
<tr>
<td>2019</td>
<td>4.0</td>
</tr>
<tr>
<td>2029</td>
<td>3.1</td>
</tr>
<tr>
<td>2039</td>
<td>2.7</td>
</tr>
</tbody>
</table>
DC md suburbs - where do seniors live?

- Single Family: 60.0%
- Townhouse/Duplex: 10.0%
- Low Rise: 20.0%
- High Rise: 30.0%
we are making decisions for the generations that follow
population impact on future housing supply - transportation

inner city

-25% Single Family
+86% Other Ground Oriented
+6% Apartment

suburbs

-8% Single Family
+10% Other Ground Oriented
+25% Apartment
where is the growth?
development patterns - 1901 calgary
development patterns - 1911
development patterns - 1921
development patterns - 1931
development patterns - 1941
development patterns - 1951
development patterns - 1971
development patterns - 1991
development patterns - 2001
development patterns - 2016

what’s left
efficient infrastructure
role of transit
where will growth happen? - md dc suburbs
where will growth happen? - md dc suburbs

- 48% preserved
- 20% developed pre 1960
- 27% developed post 1960
- 4% undeveloped
where will growth happen? - md dc suburbs

single family homes = 75% of the built land
69% of the housing
98% of the residential zoning
how much land is left to build on?

only 28,000 acres left to develop by 2030

expect 200,000 people - new 77,500 hh
166,000 new jobs

where are they going to put everyone?
type of future residential - changes what gets built

single family detached

19% of the new units consume 70% of the land needed

81% of new units will be multi family - 180 degree
land use drives the % of HH costs dedicated to transportation $
impact of employment shifts - DC md suburbs
Between 2000 and 2010, Anchorage metropolitan area’s population grew 19.2%, and population density increased.

For the average of all U.S. metro areas of similar size, population grew less, and density decreased over the same period.
transportation decisions last generations
DC md suburbs - consequences
paying for it
taxable property summary - calgary

<table>
<thead>
<tr>
<th></th>
<th>assessed value</th>
<th>percentage</th>
<th>2013 taxes (est)</th>
</tr>
</thead>
<tbody>
<tr>
<td>residential</td>
<td>$173,624,100,000</td>
<td>74 %</td>
<td>608,000,000</td>
</tr>
<tr>
<td>non residential</td>
<td>61,287,100,000</td>
<td>26 %</td>
<td>616,000,000</td>
</tr>
</tbody>
</table>

downtown makes up 37 % of all non residential value
special taxing districts - md

financing capital improvements
  water | wastewater | roads | transit | ped facilities
a new tax - levy
value tax capture - st. louis

tax increment revenue repays the bonds
value tax **capture**
purple line - within ½ mile
value tax capture

new revenues - above the base condition

property tax  motor fuel tax
titling tax   vehicle registration tax
income tax   vehicle repair tax
licence renewal  tolling
mitigation fees  impact fees
land transfer fees  development application fees
building permits  energy tax revenue
Table 2: Purple Line – Cases Matrix

<table>
<thead>
<tr>
<th>Case</th>
<th>TIF Revenue</th>
<th>Special Assessment Revenues</th>
<th>DIF Revenues</th>
</tr>
</thead>
</table>
|       | MDOT Share of Tax Increment | Residential
        (cents per $100 valuation) | Commercial
        (cents per $100 valuation) | Residential
        (per unit)¹ | Commercial
        (per sq ft) |
| Case A | 33% | None | 5 cents | $1,595 | $5 |
| Case B | 50% | None | 10 cents | $3,190 | $5 |
| Case C | 60% | None | 20 cents | $6,380 | $5 |
| Case D | 70% | 5 cents | 10 cents | $1,595 | $10 |
| Case E | 85% | 10 cents | 20 cents | $3,190 | $10 |
| Case F | 100% | 20 cents | 30 cents | $6,380 | $10 |

¹ Revenue per unit = Revenue per sq ft * (valuation / unit size)
Table 3: Purple Line - Cases Comparison (in millions)

<table>
<thead>
<tr>
<th>Case</th>
<th>TIF Revenues</th>
<th>Special Assessment Revenues</th>
<th>DIF Revenues</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PV of Total Revenue</td>
<td>Bonding Capacity of Revenue</td>
<td>PV of Total Revenue</td>
</tr>
<tr>
<td>Case A</td>
<td>$429</td>
<td>$330</td>
<td>$58</td>
</tr>
<tr>
<td>Case B</td>
<td>$652</td>
<td>$501</td>
<td>$116</td>
</tr>
<tr>
<td>Case C</td>
<td>$792</td>
<td>$609</td>
<td>$234</td>
</tr>
<tr>
<td>Case D</td>
<td>$906</td>
<td>$697</td>
<td>$185</td>
</tr>
<tr>
<td>Case E</td>
<td>$1,107</td>
<td>$852</td>
<td>$372</td>
</tr>
<tr>
<td>Case F</td>
<td>$1,313</td>
<td>$1,010</td>
<td>$634</td>
</tr>
</tbody>
</table>
# Operating Costs & Revenue - Condo vs Subdivision

<table>
<thead>
<tr>
<th>Property Type</th>
<th>Tribeca</th>
<th>Coventry Hills</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Property Tax</td>
<td>$28.5 mill</td>
<td>$2.8 mill</td>
<td>10.2 X</td>
</tr>
<tr>
<td>Land Area</td>
<td>72 m</td>
<td>1.1 km</td>
<td>15.6 X less</td>
</tr>
<tr>
<td>Street Frontage</td>
<td>72 m</td>
<td>1.1 km</td>
<td>15.6 X less</td>
</tr>
</tbody>
</table>
### Does Infill Pay?

<table>
<thead>
<tr>
<th></th>
<th><strong>New Condo</strong></th>
<th><strong>Previous Use</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td># of units</td>
<td>114</td>
<td>11 singles &amp; 4plexes</td>
</tr>
<tr>
<td>Property tax</td>
<td>$272,000</td>
<td>$35,381</td>
</tr>
<tr>
<td>Per occupant</td>
<td>$1,359</td>
<td>$585</td>
</tr>
</tbody>
</table>
examples
Dallas - Light Rail - 1993 - 2013

Within ¼ mile of transit

- $751 m in residential
- $224 m in offices
- $393 m in retail

50,000 jobs  157% return on investment
cleveland - bus rapid transit

$200 million healthlink brt generated $4 b economic benefit
4,000 new homes | 7.9 m ft2 of commercial | 13,000 jobs
29 m passengers in one year - > 31% in 4 yrs
level boarding | frequent service
grand rapids mi
9.6 mile silver line brt - residential to medical mile
4,500 daily riders
32% increase over regular bus
2nd line in planning
754 jobs & $88 million created
high floor LRT vehicles
not a street car - proposed expansion 26 m = $500+ ml
focus on moving people distances to jobs
102 million riders in 2017 - < 7% = revenue shortfall
toronto - combinations - street car, subway, regional rail
Toronto - Calgary other cities have parking maximums
houston - dedicated right of way
Montgomery County, MD - 

BRT vs LRT

Transitway - linking tech corridor to density

<table>
<thead>
<tr>
<th></th>
<th>LRT</th>
<th>BRT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost</td>
<td>$832 m</td>
<td>$545 m*</td>
</tr>
<tr>
<td>Phasing</td>
<td>longer</td>
<td></td>
</tr>
<tr>
<td>Economic Impact</td>
<td>45 % &gt;</td>
<td></td>
</tr>
<tr>
<td>Tax Impact</td>
<td>65 % &gt;</td>
<td></td>
</tr>
<tr>
<td>Jobs</td>
<td>70% &gt;</td>
<td></td>
</tr>
</tbody>
</table>

*2012 $
nashville tn - 2014

state tried to outlaw transit only lanes to prevent BRT

austin tx - bus system revamp

retire long - low ridership routes
combine others into more efficient routes
reduce service to 15 min intervals
develop transit apps
boldness changes everything
control the things you can - factor in those you cannot

price of gas
real estate prices - walk score
personal airborne transportation (pats)
some will drive
make sure you reach the people who need it
putting it all together
an idea
keep with the bus plan
narrow some streets
network of vanpools, car share, slugging, employee shuttle
add a lane - HOV, BRT, vanpool | reverse lane
question