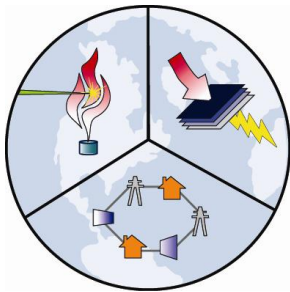# STREET

Determining hydrogen fueling station needs in targeted communities

ADVANCED POWER & ENERGY PROGRAM

UNIVERSITY of CALIFORNIA · IRVINE

Shane Stephens-Romero
Tim Brown, PhD
Professor Scott Samuelsen
13 July 2011

STREET
Spatially and Temporally Resolved
Energy and Environment Tool

STREET
Spatially & **T**emporally **R**esolved **E**nergy & **E**nvironment **T**ool

DEVELOPMENT:

University of California, Irvine –
Advanced Power & Energy Program (APEP)
In collaboration with the:
UCI Computational Environmental Sciences Laboratory
Institute for Transportation Studies

SUPPORT
- U.S. Department of Energy
- California Energy Commission
- California Air Resources Board
- South Coast Air Quality Management District
- San Joaquin Air Pollution Control District
- U.S. Environmental Protection Agency

PARTNERSHIPS

- Air Products
- Toyota
- Honda
- General Motors
- Hyundai

- Mercedes-Benz
- Nissan
- Mazda
- Shell
- Linde

STREET
Spatially and Temporally Resolved
Energy and Environment Tool
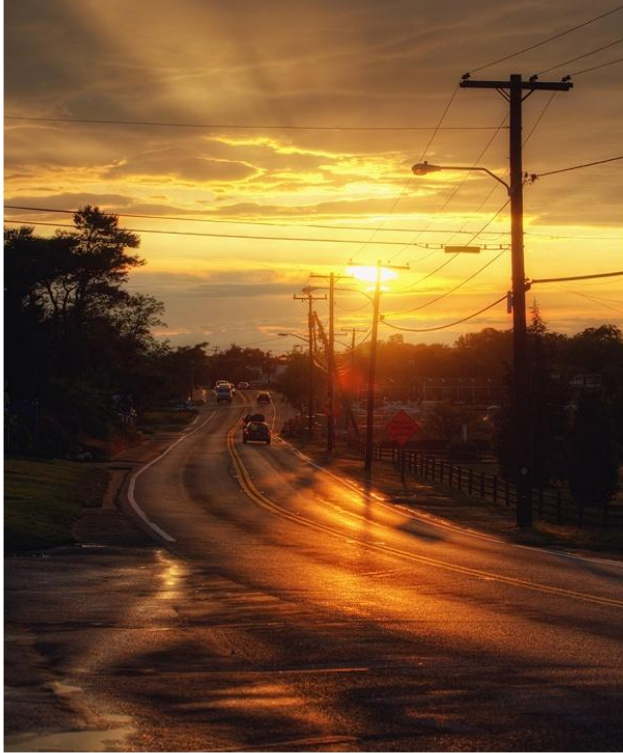
STREET
Spatially & Temporally Resolved Energy & Environment Tool

OPERATION:

STREET is A systematic and highly detailed, land-use based methodology that establishes and evaluates fuel infrastructure scenarios

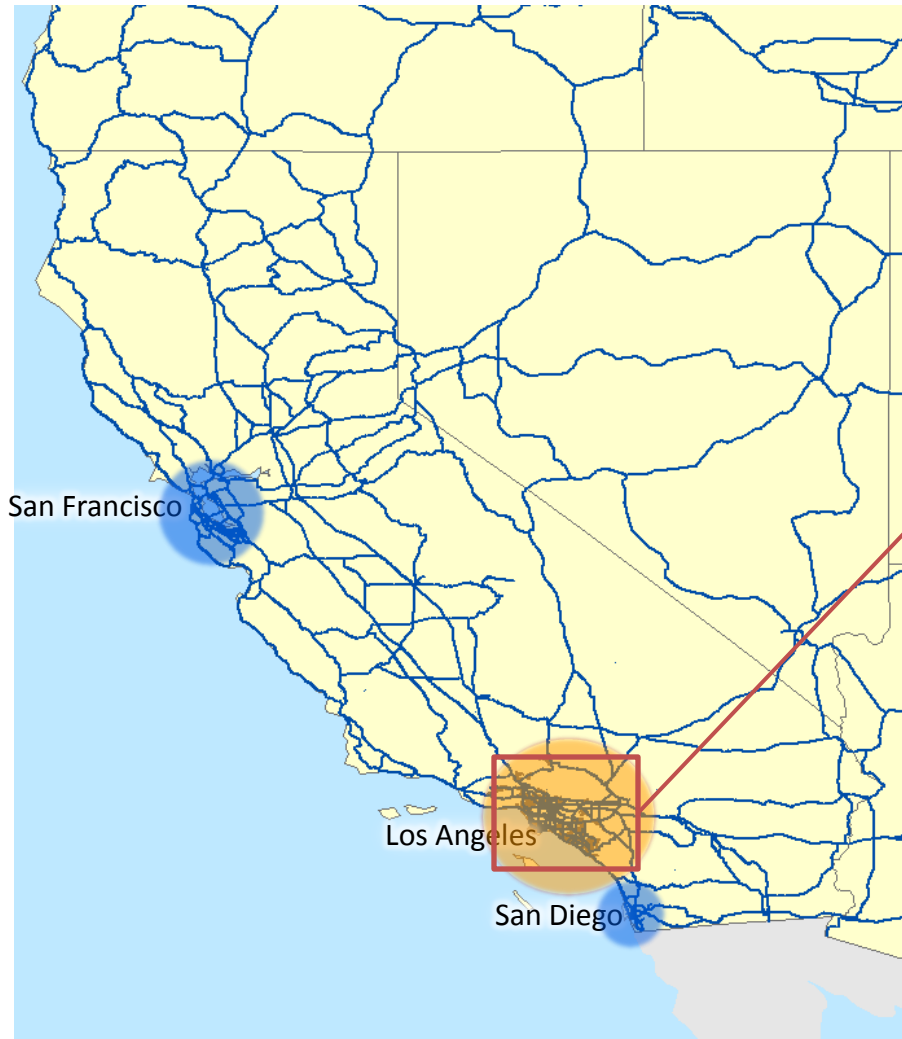Provides insight into alternative fuel planning and investment with respect to:

1. Fully built-out infrastructure and long-term environmental goals
2. Roll-out and near-term infrastructure needs
   - Hydrogen refueling stations

Hydrogen Station Analysis

San Francisco

Los Angeles

San Diego

Santa Monica

Redondo Beach

Newport Beach

Dana Point

Hydrogen Station Analysis

Determining Preferred Hydrogen Stations

(i) Number of hydrogen stations required to provide an acceptable level of service for drivers in a targeted region

(ii) Optimized locations
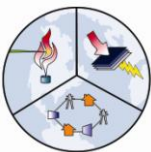
(iii) Preferred rollout strategy

Steps of analysis:

→ 1. *Select target region (OEM data)*

2. *Travel-time algorithm*

3. *Station land use*

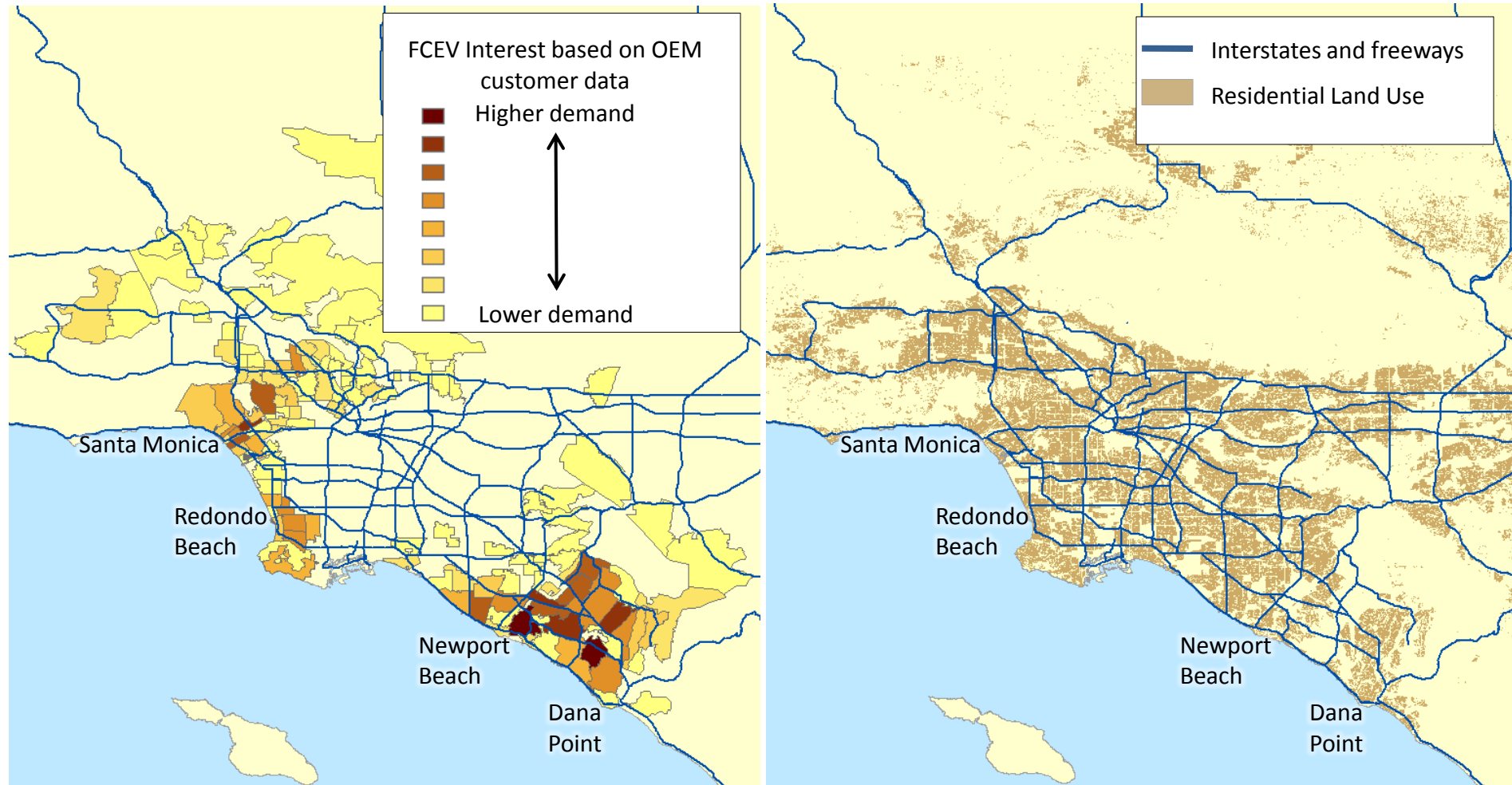4. *Vehicle travel density*

5. *Service coverage*

Target regions:

Santa Monica/West LA

Torrance and Beach Cities

Southern and costal Orange County

Southern California: FCEV Demand
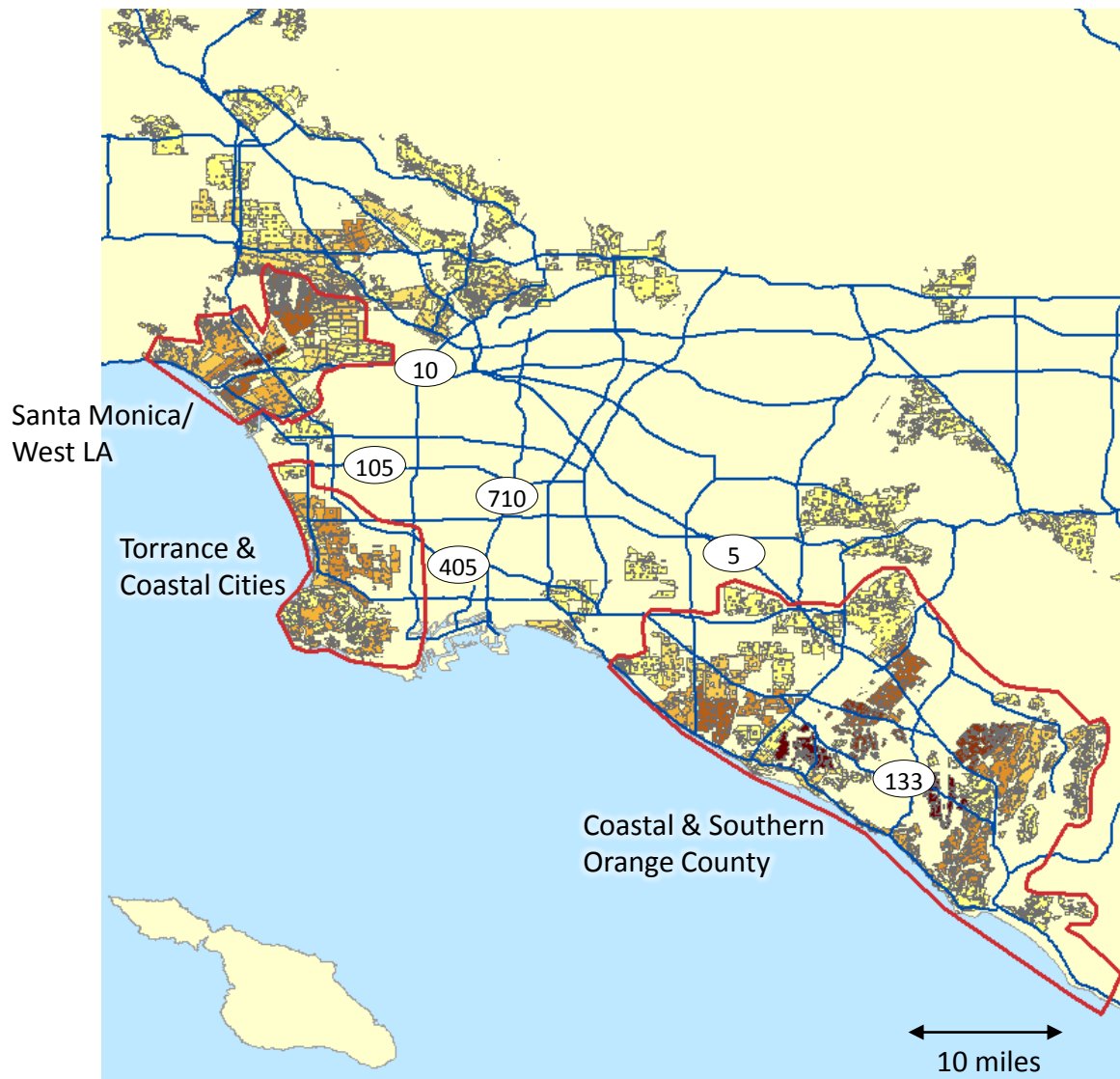

FCEV Interest based on OEM customer data
Higher demand
↑
↓
Lower demand

Santa Monica

Redondo Beach

Newport Beach

Dana Point

Interstates and freeways
Residential Land Use

Santa Monica

Redondo Beach

Newport Beach

Dana Point

Southern California: FCEV Demand

Santa Monica/West LA

Torrance & Coastal Cities

Coastal & Southern Orange County

10 miles

Legend:
- Interstates and freeways
- FCEV target regions
- FCEV Interest based on OEM customer data
  - Higher interest
  - Lower interest
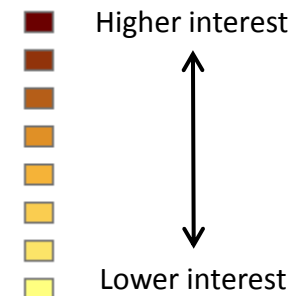
Hydrogen Station Analysis

Determining Preferred Hydrogen Stations

(i)   Number of hydrogen stations required to provide an acceptable level of service for drivers in a local community

(ii)   Optimized locations

(iii)   Preferred rollout strategy

Steps of analysis:

1. *Select target region (OEM data)*

2. *Travel-time algorithm*

3. *Station land use*   UC Irvine Institute for Transportation Studies

4. *Vehicle travel density*

5. *Service coverage*

Hydrogen Station Analysis

Determining Preferred Hydrogen Stations

(i) Number of hydrogen stations required to provide an acceptable level of service for drivers in a local community

(ii) Optimized locations

(iii) Preferred rollout strategy
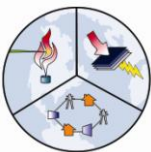
Steps of analysis:

1. *Select target region (OEM data)*

→ 2. *Travel-time algorithm*

→ 3. *Station land use*

4. *Vehicle travel density*

5. *Service coverage*

Legend:
- Interstates and freeways
- Principal Arterial Roads
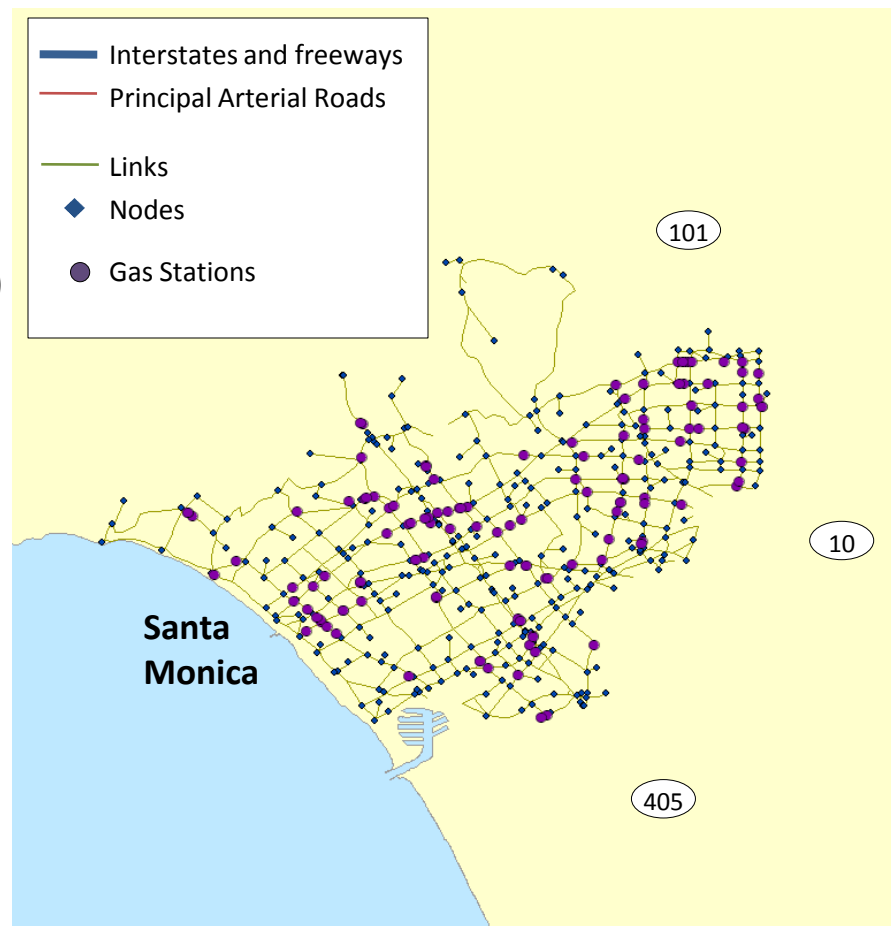- Links
- ◆ Nodes
- ● Gas Stations

Santa Monica

101
10
405

Hydrogen Station Analysis

Determining Preferred Hydrogen Stations

(i) Number of hydrogen stations required to provide an acceptable level of service for drivers in a local community

(ii) Optimized locations

(iii) Preferred rollout strategy

Steps of analysis:

1. *Select target region (OEM data)*

→ 2. *Travel-time algorithm*
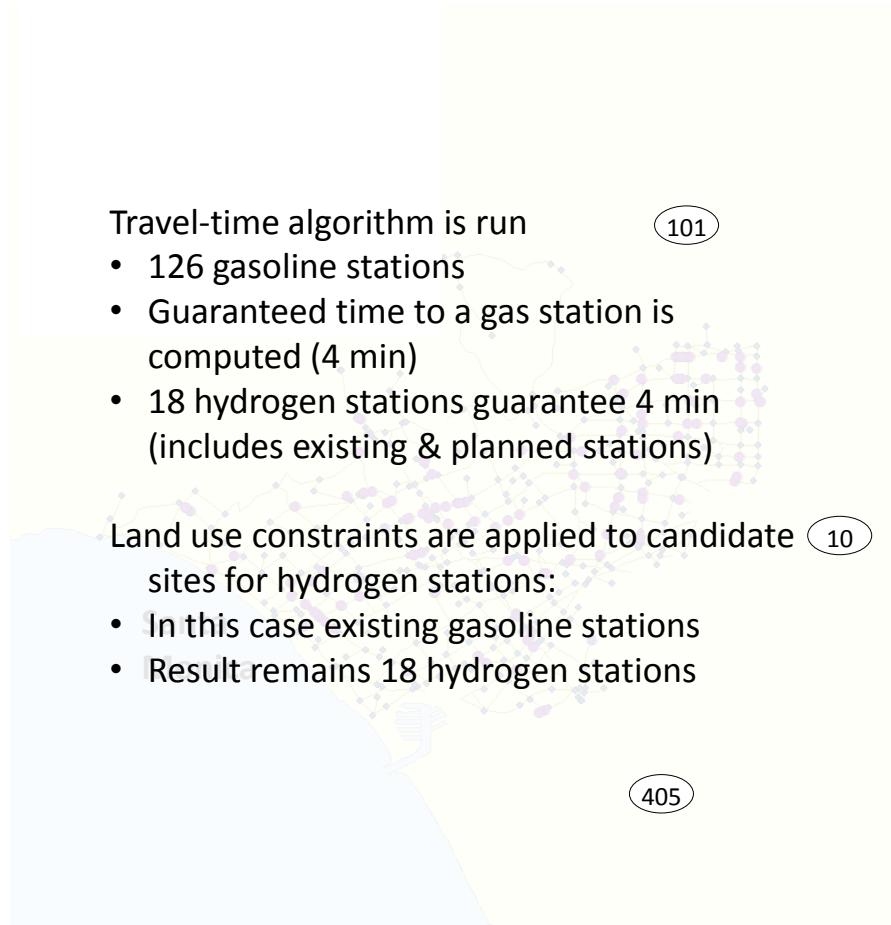
→ 3. *Station land use*

4. *Vehicle travel density*

5. *Service coverage*

Travel-time algorithm is run (101)
- 126 gasoline stations
- Guaranteed time to a gas station is computed (4 min)
- 18 hydrogen stations guarantee 4 min (includes existing & planned stations)

Land use constraints are applied to candidate (10)
sites for hydrogen stations:
- In this case existing gasoline stations
- Result remains 18 hydrogen stations

(405)

Hydrogen Station Analysis

Determining Preferred Hydrogen Stations

(i) Number of hydrogen stations required to provide an acceptable level of service for drivers in a local community

(ii) Optimized locations

(iii) Preferred rollout strategy

Steps of analysis:

1. *Select target region (OEM data)*

2. *Travel-time algorithm*

3. *Station land use*

→ 4. *Vehicle travel density*

5. *Service coverage*

Hydrogen Station Analysis

Determining Preferred Hydrogen Stations

(i)   Number of hydrogen stations required to provide an acceptable level of service for drivers in a local community

(ii)   Optimized locations

(iii)   Preferred rollout strategy

Steps of analysis:

1. *Select target region (OEM data)*

2. *Travel-time algorithm*

3. *Station land use*

4. *Vehicle travel density*

5. *Service coverage*
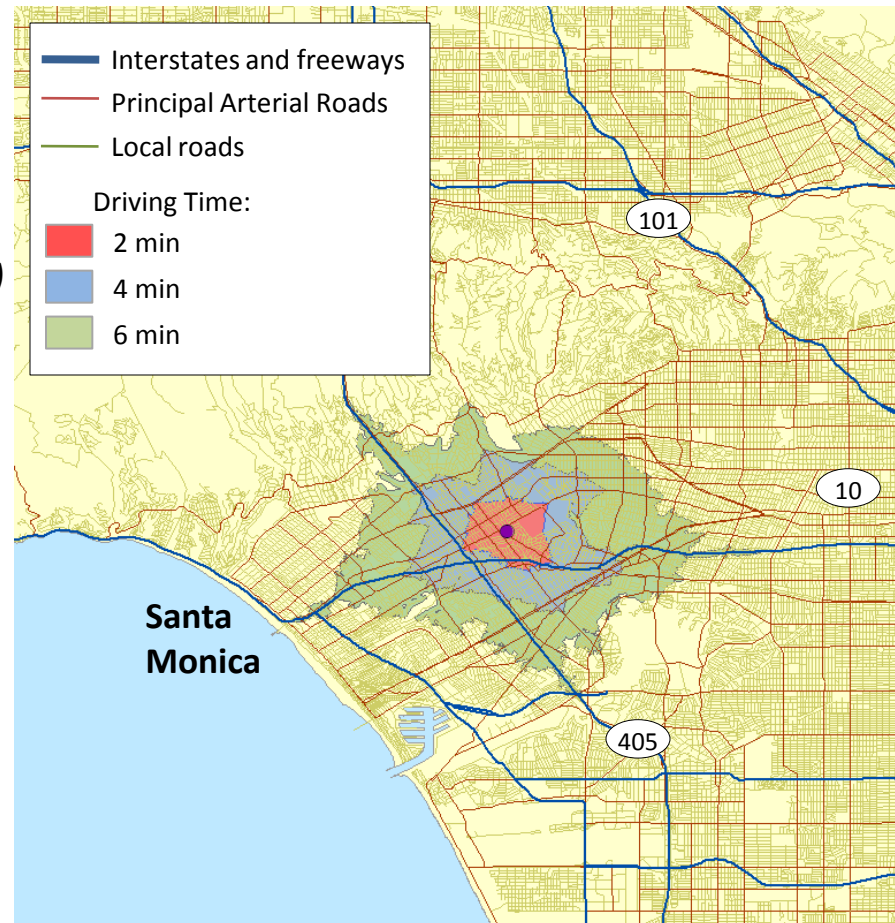

Legend:
- Interstates and freeways
- Principal Arterial Roads
- Local roads

Driving Time:
- 2 min
- 4 min
- 6 min

Santa Monica

101   10   405

Hydrogen Station Analysis

Legend:
- Interstates and freeways
- Principal arterial roads

Driving Time:
- 2 min
- 4min
- 6min

Gasoline stations (126)

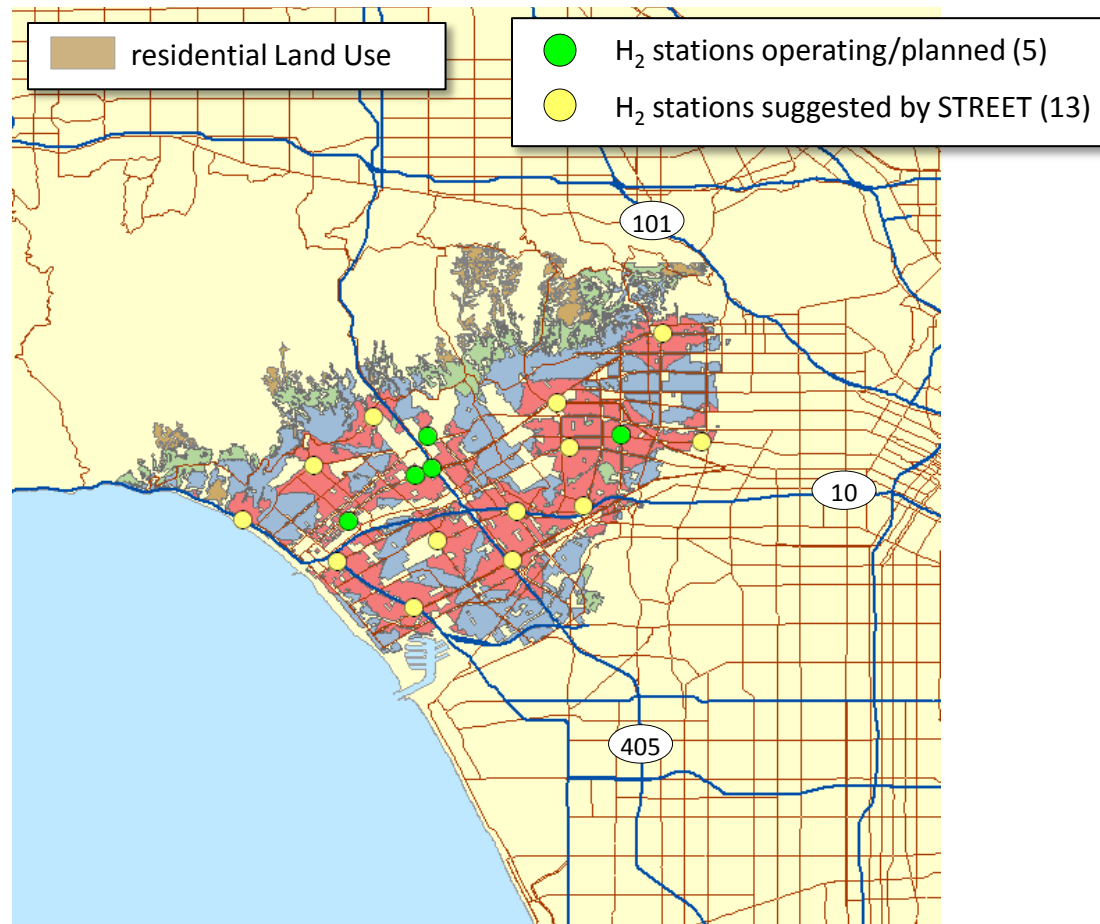H₂ stations operating/planned (5)
H₂ stations suggested by STREET (13)

Santa Monica

© Advanced Power and Energy Program, 2011

Hydrogen Station Analysis

Legend:
- Interstates and freeways
- Principal arterial roads

Driving Time:
- 2 min (red)
- 4 min (blue)
- 6 min (green)

- residential Land Use
- H₂ stations operating/planned (5)
- H₂ stations suggested by STREET (13)

Hydrogen Station Analysis

© Advanced Power and Energy Program, 2011
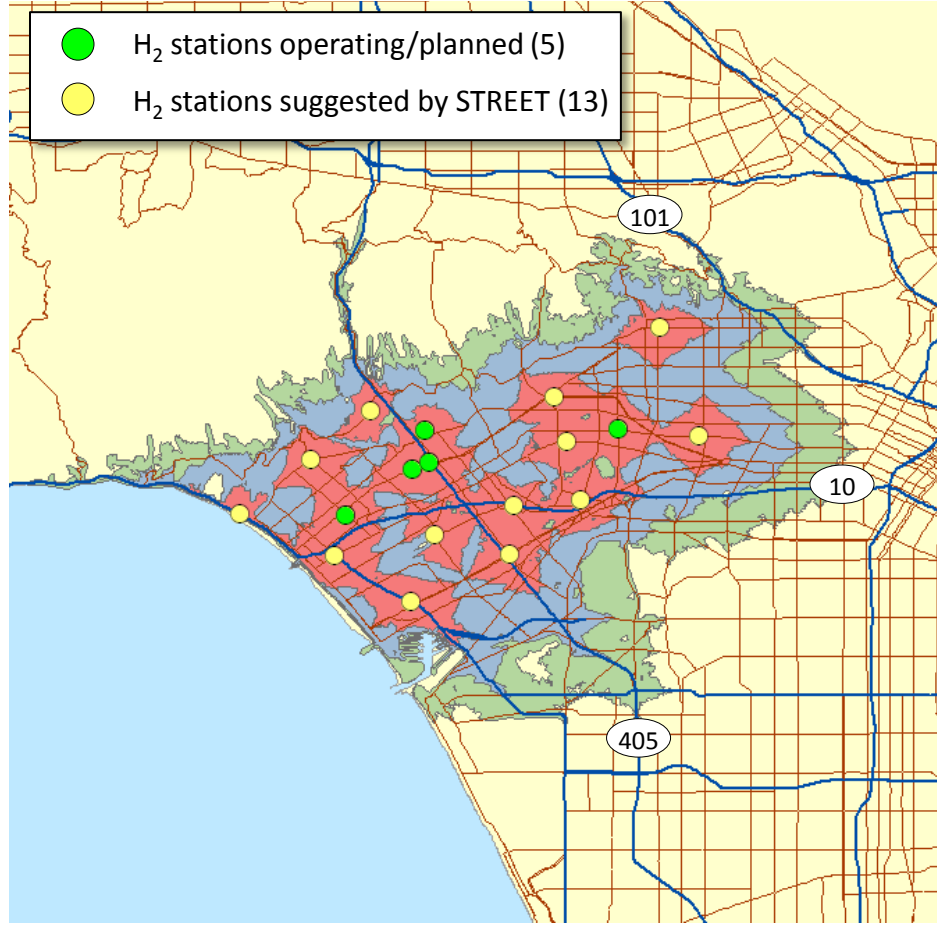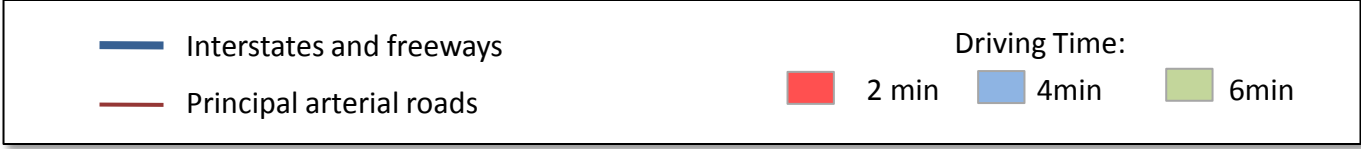
Hydrogen Station Analysis

Portion of **residential land** covered by
gasoline vs. hydrogen service area:

Travel Time (min)	126 Gasoline Stations	18 Hydrogen Stations
6	99.1%	97.0%
4	87.9%	85.0%
2	73.0%	44.4%

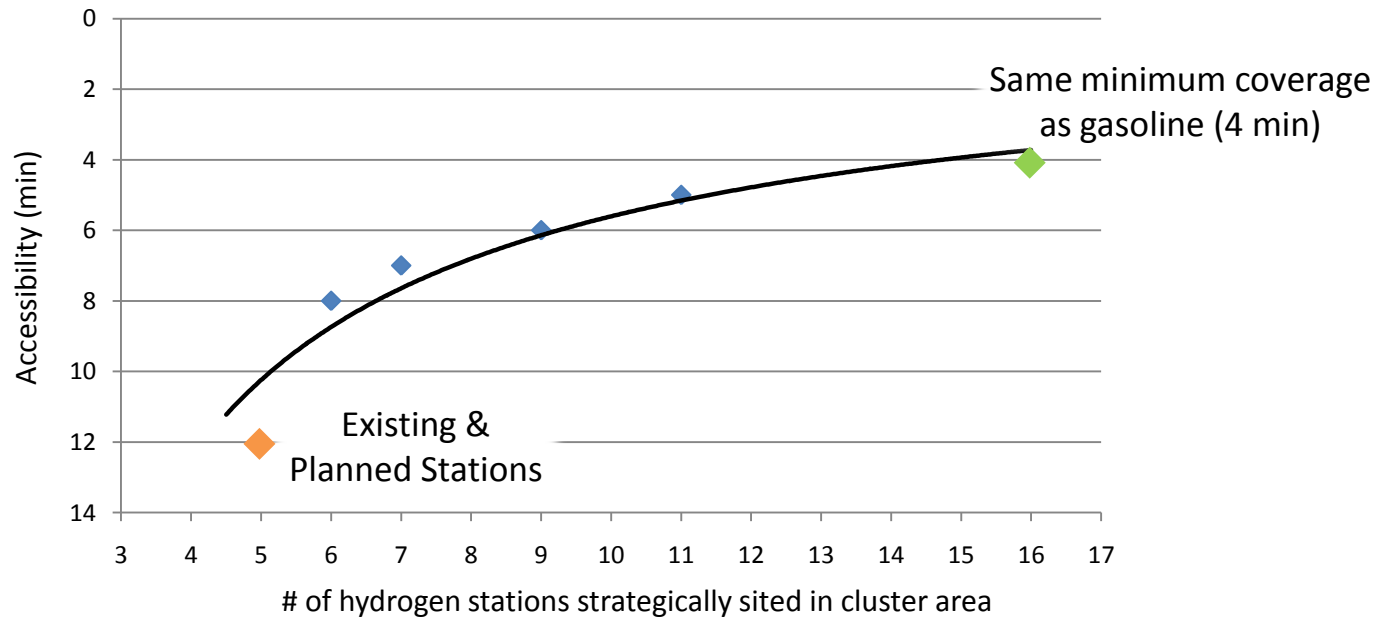Other metrics:

Portion of roads covered

Population covered

…

Hydrogen Station Analysis

Determining Preferred Hydrogen Stations

✓ **(i)   Number of hydrogen stations required to provide an acceptable level of service for drivers in a local community**

✓ **(ii)   Optimized locations**

(iii)   Preferred rollout strategy

Santa Monica & West LA

Same minimum coverage as gasoline (4 min)

Existing & Planned Stations

Accessibility (min)

# of hydrogen stations strategically sited in cluster area

Hydrogen Station Analysis

H$_2$ station analysis is designed for flexibility:

Capability to suggest optimized locations OR include proposed stations as input

Legend:
- 🟢 H$_2$ stations operating/planned (5)
- 🟡 Optimized H$_2$ stations STREET (13)
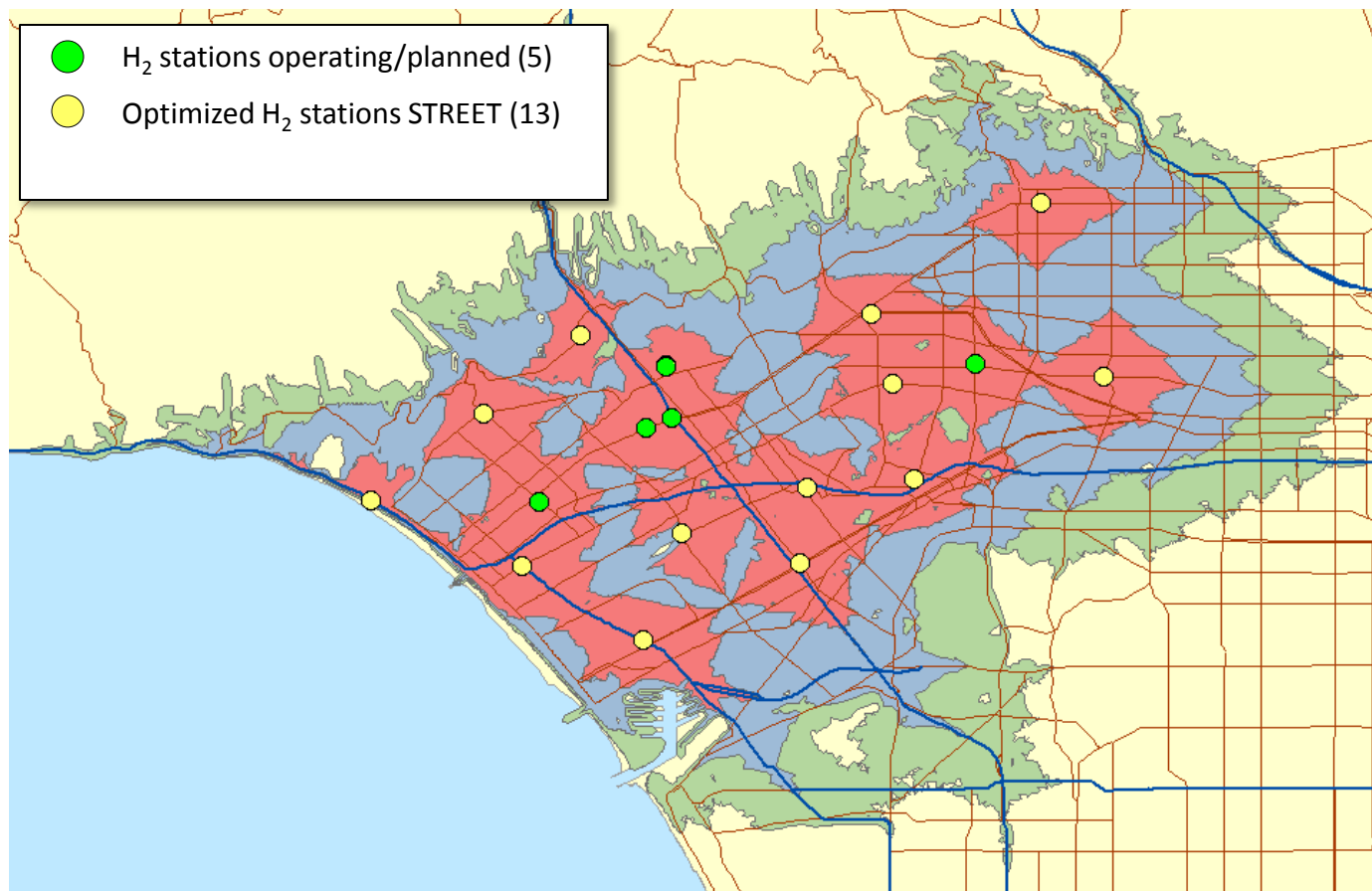
Hydrogen Station Roll-Out

H_2 station analysis is designed for flexibility:

Capability to suggest optimized locations OR include proposed stations as input

Legend:
- 🟢 H_2 stations operating/planned (5)
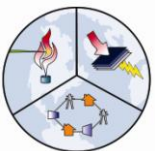- 🟡 Optimized H_2 stations STREET (13)
- 🟣 Proposed station H_2
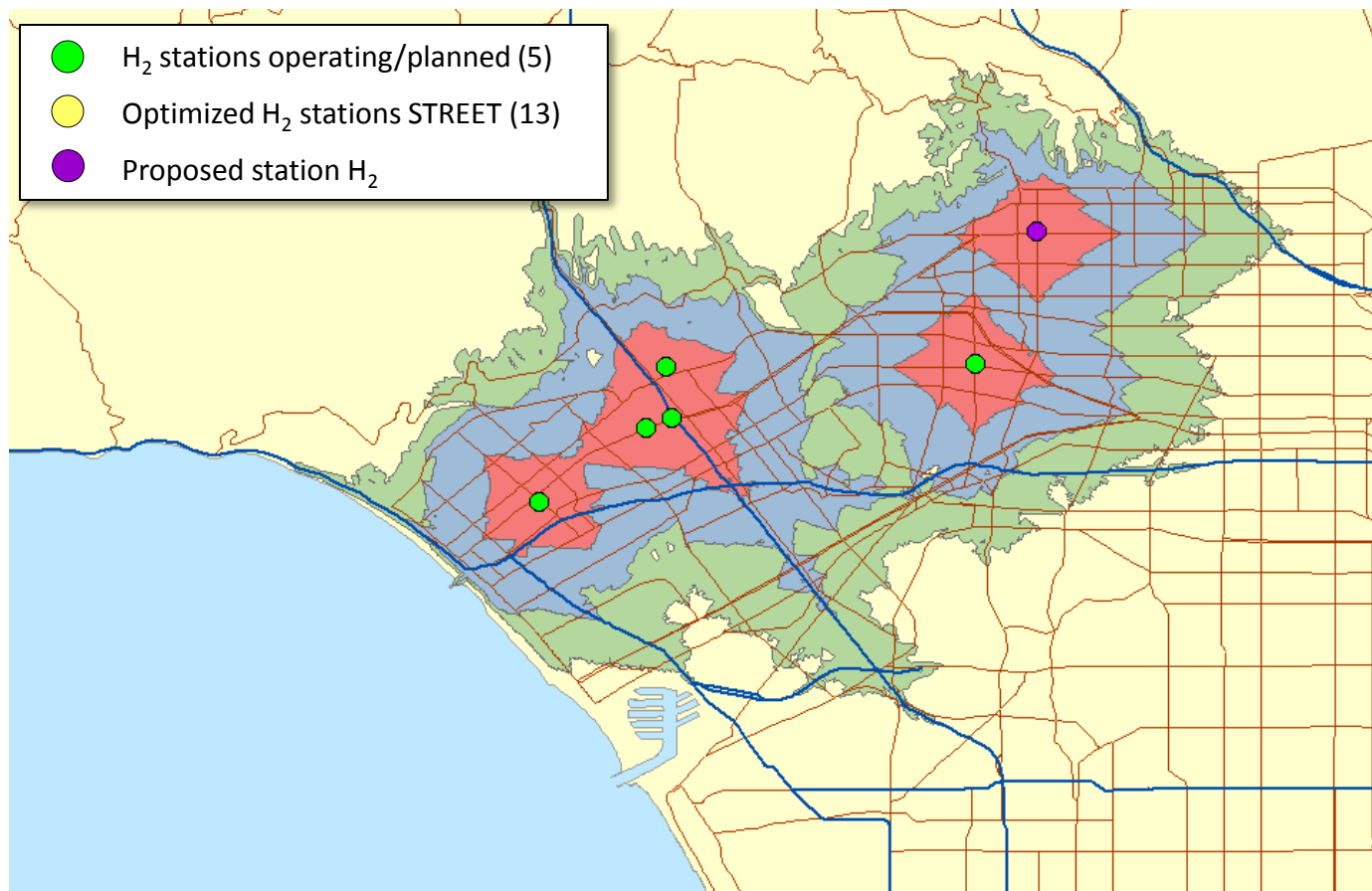
Hydrogen Station Analysis

H$_2$ station analysis is designed for flexibility:

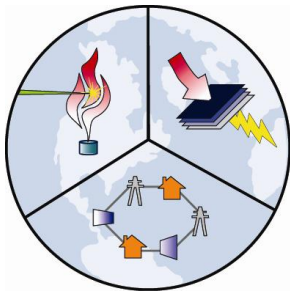Capability to suggest optimized locations OR include proposed stations as input

Allows stakeholders to determine accessibility needs

The flexibility has already been put into practice with industry and government stakeholders

STREET

Determining hydrogen fueling station needs in targeted communities

ADVANCED POWER & ENERGY PROGRAM
UNIVERSITY *of* CALIFORNIA · IRVINE

Shane Stephens-Romero
Tim Brown, PhD
Professor Scott Samuelsen
13 July 2011