Davis
Future Renewable Energy and Efficiency (DavisFREE)

California Energy Commission
Community Scale Renewable Energy Integration Workshop

July 29, 2015

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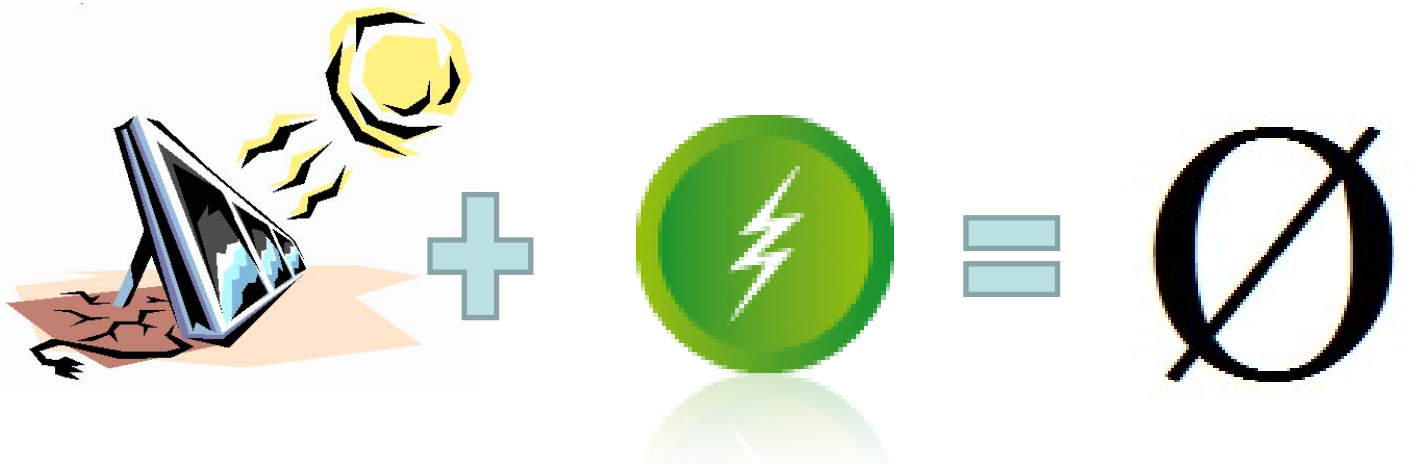
City of Davis

DavisFREE Overview

- Support implementation planning for the Davis "Climate Action and Adaptation Plan" by creating a renewable energy and energy efficiency roadmap for Davis
- Targets building-related energy efficiency and renewable energy improvements to reduce greenhouse gas emissions
- Data-driven approach: PG&E and Davis GIS
- Project Partners – NGO's, UC Davis, Private Sector Firms

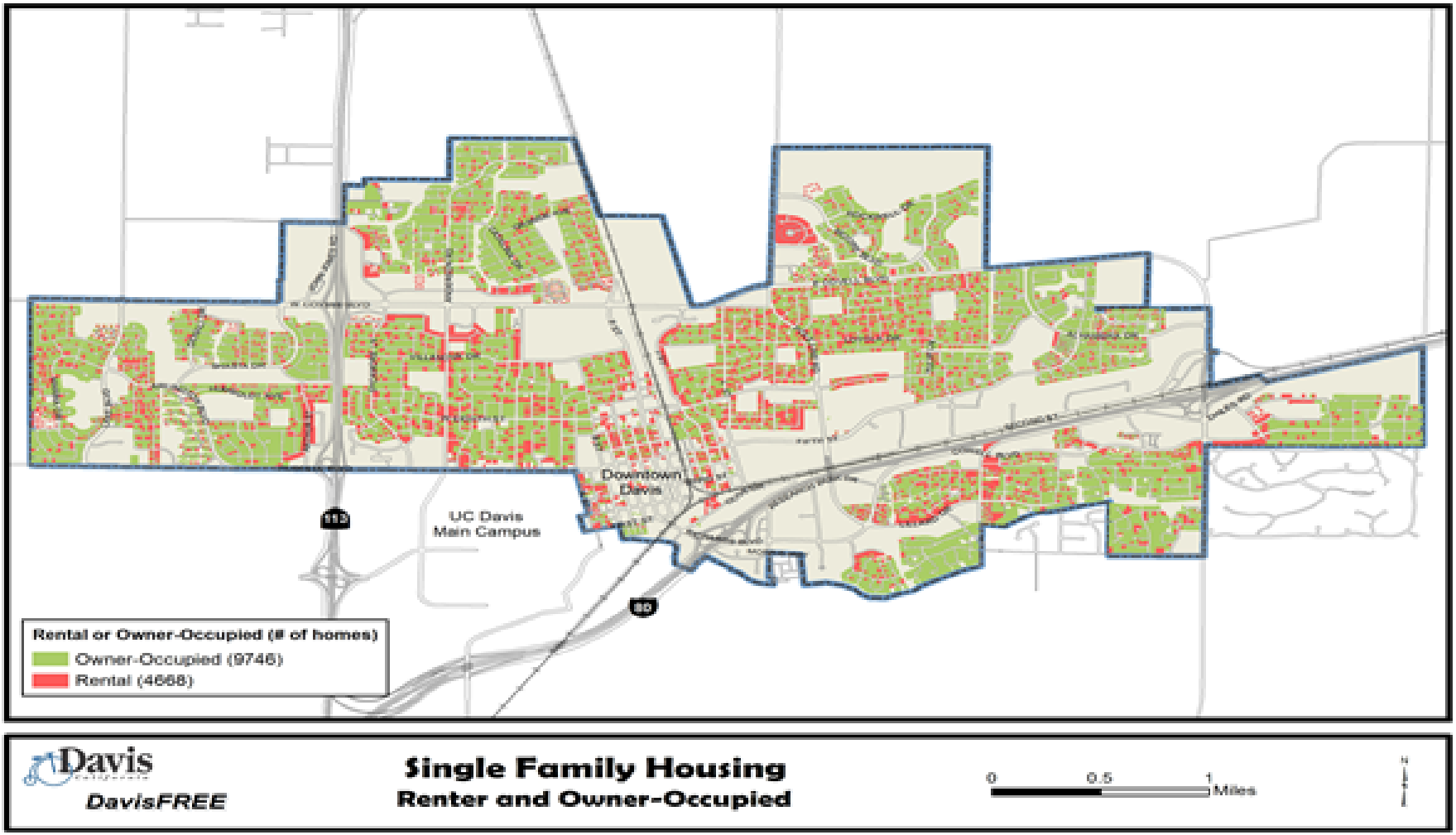
DavisFREE Goal



How?
DavisFREE Research Topics

1. Net Zero Residential Retrofit Program Design – BIRA
2. Local Solar Electricity Sites and Resources
   - Rooftop Solar Electricity Potential - BIRA
   - Assessment of Solar Garden Sites – UCD
3. Local Solar Thermal Sites and Resources – Aztec
4. Utility Scale Renewable Energy Opportunities – UCD & KEMA
5. Integrated Renewable Energy Deployment Scenarios - IRESN

Understanding the community - data



1. Zero Net Energy Guidelines for Existing Residential Buildings (BIRA)

- Residential sector accounts for 64% of the total energy use in Davis (Electricity + Nat Gas + Trans), making it a key sector to impact Davis' carbon footprint

- Characterized homes by Decade Built and Construction Features; developed retrofit models for 3 scenarios
  - *Good*: Cost-Effective, Affordable
  - *Better*: Between Good and Best
  - *Best*: ZNE with Moderate PV

- Volume Retrofit Market Approach
  - Innovative "Neighborhood Approach" to residential retrofits
  - Proven social marketing approach
  - Guide developed for and tailored to Davis

Efficiency Measure	Baseline	Good	Better	Best
Ceiling Insulation	Vented Attic, R-13 flat on ceiling	Vented Attic, R-49 (new) flat on ceiling	Attic Sealed, R-38 under roof deck	Attic Sealed, R-38 under roof deck
Roof Characteristics	Asphalt Shingles, Dark	Asphalt Shingles, Dark	Cool Roof (Abs. =0.2 / Emiss. =0.5)	Cool Roof (Abs. = 0.2 / Emiss. = 0.5)
Windows (U-factor / SHGC)	U=0.76, SHGC=0.67	U=0.32, SHGC=0.25	U=0.32, SHGC=0.25	U=0.32, SHGC=0.25
Air Leakage (ACH_{50})	15 ACH_{50}	9 ACH_{50}	2.5 ACH_{50}	2.0 ACH_{50}
Refrigerator (25 cu.ft. side x side) EF	EF=15.7	EF=20.6	EF=20.6	EF=20.6
Lighting (% LED)	100% Incadescent	100% LED, both hardwired and plugin	100% LED, both hardwired and plugin	100% LED, both hardwired and plugin
HVAC Cooling A/C SEER	SEER 13	SEER 16	SEER 18	N/A
HVAC Gas Furnace HSPF	Gas, 78% AFUE	Gas, 92.5% AFUE	Gas, 92.5% AFUE	N/A
Heat Pump (SEER, HSPF)		N/A	N/A	SEER 18 & HSPF 9.5
Duct Verified Leakage (% Total Fan Flow)	15% leakage	7.5% Leakage	In finished space; $\leq$ 7.5%	In finished space; $\leq$ 7.5%
Duct Location and Insulation R-Value	R-2.1 ducts - vented attic	R-8 ducts - vented attic	R-8 ducts in sealed, semi-conditioned attic	R-8 ducts in sealed, semi-conditioned attic
Water Heating	Gas Standard	Gas Tankless, Condensing	Gas Tankless, Condensing	HPWH, 50 gal (4.0 COP)
Solar Water Heating	N/A	N/A	64ft Closed-Loop or equiv	64ft Closed-Loop or equiv
Whole House Energy Savings		33%	42%	Efficiency Only: 50% Add 4.6kW PV: 100%

Equipment sizing requirements (1970's vintage)

HVAC Size to Meet Loads	Baseline	Good	Better	Best
Cooling (Tons)	6.2	3.1	2.1	2.1
Heating (kBtu/hr)	47.8	27.1	17.7	13.1
% Reduction HVAC Size	-	47%	65%	69%
PV for ZNE (kW required for 100% source energy savings)	9.3	6.2	5.4	4.6

2. Rooftop PV Potential Study

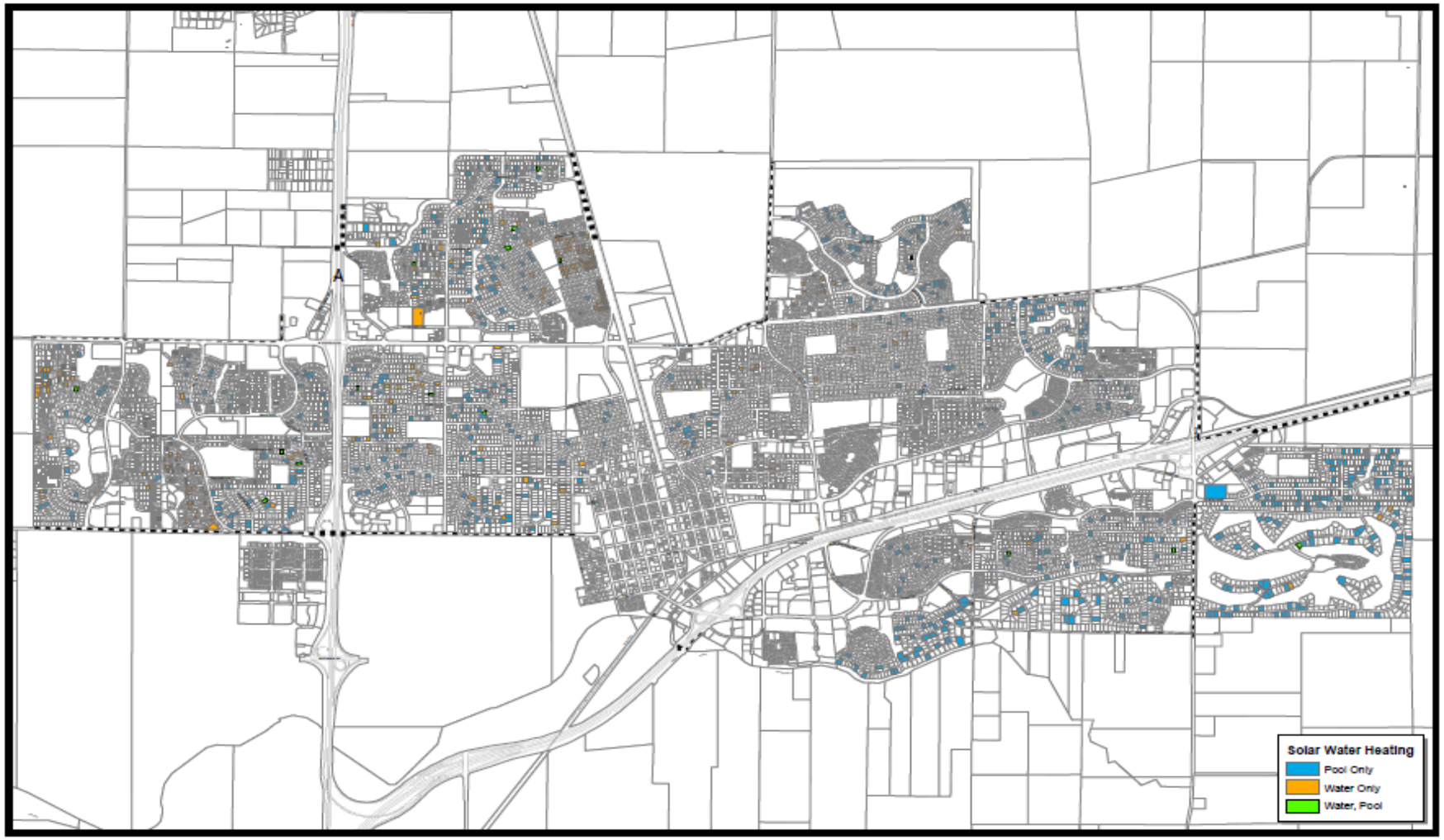
- 221 MW potential
- Sufficient Electricity for 30,000 homes
- Greater than the # of homes in Davis.

3. Solar Thermal Water Heating (Aztec Solar)

- SWH offsets natural gas use at source; reduces GHG by ~30% in homes

- Analyses and inventories
  - Domestic hot water - homes and apt complexes
  - Swimming pools - residential and commercial
  - GHG reduction calcs for common commercial applications
  - Mapped all existing SWH and PV

- New PG&E incentives and FTC make the economics very good; PACE and other financing options



Solar Water Heater (Water and Pool)
City of Davis

0 4,250 8,500 Feet

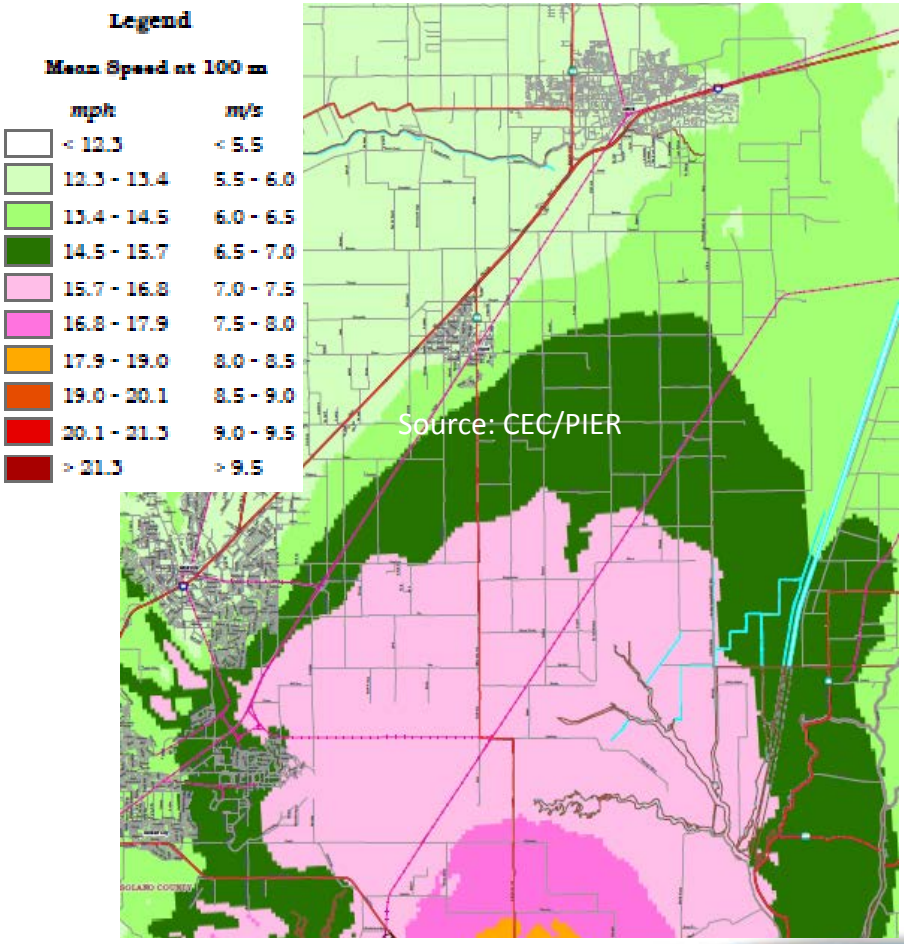
4. Utility Scale RE Opportunities (UC Davis & KEMA)

City Controlled Community Solar Sites

Property	Acres	MW
Davis Municipal Golf Course	149	20
Old City Landfill/PVUSA Site	186	25
Wastewater Treatment Plant	224	30
Howatt/Clayton Ranch	773	103
Wastewater Treatment Plant	2	0
Playfields Park	1	0
Mace Park and Ride	1	0
Pubic Works Corp Yard	4	1
Parks Corp Yard	2	0
Totals		179

Source: City of Davis/UCD

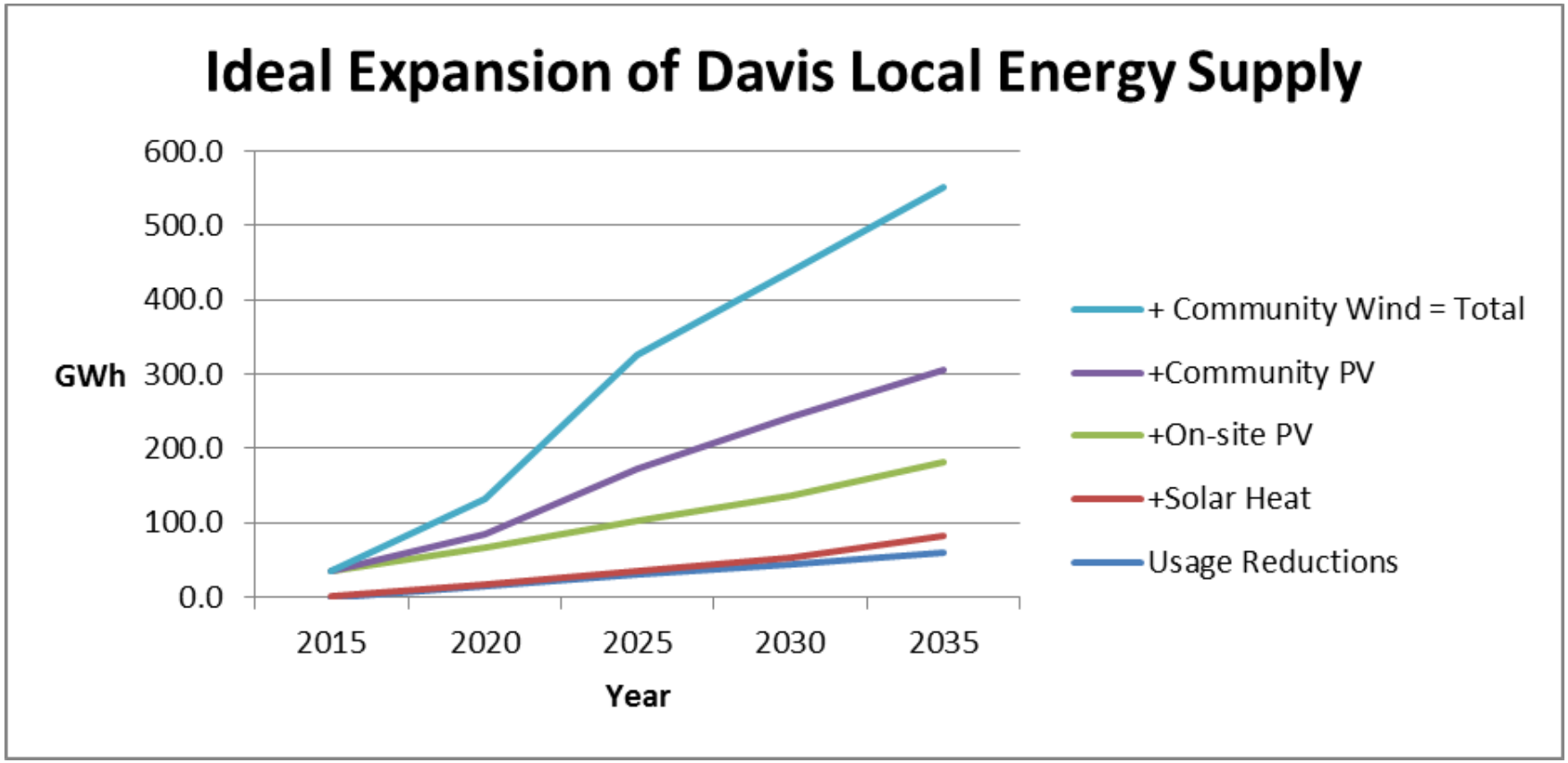
Community Wind Resource Area



5. Energy Balance: Buildings + Trans (IRESN)

Ideal Davis Energy Usage/Supply Balance - 2015 to 2035					
	2015	**2020**	**2025**	**2030**	**2035**
	Annual GWh				
Unrestrained Usage	503.9	524.9	550.1	581.7	626.8
Usage Reductions	0.0	-15.5	-30.0	-44.3	-60.4
Reduced Usage	**503.9**	**509.3**	**520.1**	**537.4**	**566.4**
Local Supply Sources					
Solar Heat	0.5	1.0	4.7	10.0	21.2
On-site PV	35.2	51.0	67.1	83.2	99.3
Community PV	0.0	18.0	72.0	104.4	126.2
Community Wind	0.0	46.7	151.6	198.3	245.0
Total Local Supply	**35.7**	**116.7**	**295.5**	**395.9**	**491.6**
Imports	**468.2**	**392.6**	**224.6**	**141.5**	**74.8**
Total Supply	**503.9**	**509.3**	**520.1**	**537.4**	**566.4**

General Renewable Deployment Roadmap



Specific Conclusions

- Most of Davis' energy usage can, realistically and economically, be supplied by a mix of local solar and wind resources, resulting in a near zero local carbon footprint within two decades.

- Community choice energy frameworks can enable development of local solar and wind resources that would not otherwise be developed. The increasing need for integration of regional utility and local planning will be an important limiting factor in these cases.

- ZNE home energy retrofits can lower residential energy use by 30% - 50%, and when integrated with solar, net-energy use can be zero.

- Solar thermal, with the new incentives, is now cost effective and can immediately reduce natural gas GHG emissions at the source, accelerating Davis' CAAP ambitions.

- The data driven Georgetown Univ Energy Prize community marketing approach offers a method of delivering DavisFREE products and results