METHODOLOGY FOR ESTIMATING ROOFTOP SOLAR FEASIBILITY ON AN URBAN SCALE
PROJECT INTRODUCTION

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PROJECT INTRODUCTION

• The project is a study of a methodology for implementing rooftop photovoltaics on an urban scale
PROJECT INTRODUCTION

• According to US Census data, there are over 200 billion sq. ft. of rooftops in the United States.¹
• If even 25% of this area is suitable for continuous PV operation the potential installed capacity exceeds over 250,000 megawatts.²
PREPARE A LIST OF CITY BUILDINGS

• Team began by searching the City of Phoenix website to identify city operated buildings
• List was cross-referenced with a list received from the city
• Compiled list identified 364 buildings spread over 475 sq. miles
GOOGLE EARTH

• Building addresses were queried by using Google Earth
• Allowed us to see general rooftop conditions and location
GOOGLE EARTH

• Team needed to verify the accuracy of measurements taken in Google Earth
GOOGLE EARTH

• One baseline measurement was acquired from each aerial that allowed the team to scale each building in either AutoCad or Sketch-Up.
IMPORTING INTO SKETCH-UP OR AUTOCAD

• Areas suitable for photovoltaic installation were highlighted on the scaled image and the respective areas were determined.
IMPORTING INTO SKETCH-UP OR AUTOCAD

• Factors Included:
  • Orientation
  • Roof Slope
  • Tree Shading
  • Roof Equipment
  • Parapets
  • Shade from Adjacent Structures
RATING THE BUILDING

• This analysis resulted in a rating for each building on a scale of 1-5
• A total 100 buildings were rated either a 4 or 5
FIELD VISITS

• Conducted on all buildings rated either a 4 or 5
• Visual documentation of roof structure, condition, and any obstructions not apparent on aerial image
• Spreadsheet was updated and changed with any new information
FIELD VISITS

• Site visits were necessary to change the ratings of buildings
• Driver Training Center
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• Aesthetic choices
System performance was estimated using the RETScreen program.
**SYSTEM PERFORMANCE**

- **Thin film/amorphous**
  - PV array power (kWp/100sq.ft.): 0.666, 0.592
  - PV array area (sq.ft.): 100, 100
  - Annual kWh/100sq.ft.: 1158.3, 1120.8
  - Peak kWp/sq.ft.: 0.00666, 0.00592
  - kWh/sq.ft.: 11.583, 11.208

- **Poly-crystalline**
  - PV array power (kWp/100sq.ft.): 1.008, 0.896
  - PV array area (sq.ft.): 100, 100
  - Annual kWh/100sq.ft.: 1647.9, 1591.2
  - Peak kWp/sq.ft.: 0.01008, 0.00896
  - kWh/sq.ft.: 16.479, 15.912

- **Mono-crystalline**
  - PV array power (kWp/100sq.ft.): 1.332, 1.184
  - PV array area (sq.ft.): 100, 100
  - Annual kWh/100sq.ft.: 2178, 2102.4
  - Peak kWp/sq.ft.: 0.01332, 0.01184
  - kWh/sq.ft.: 21.78, 21.024

Analysis was performed only on buildings rated a 4 or 5.
Performance ranging from peak solar output from 6.66 W/ft² to 11.84 W/ft².
RESULTS

• Implementation, depending on system type, could result in power production of 15.58 MWp to 27.71 MWp
• If city owned parking structures were included, an additional 13 MWp - 23 MWp could be generated
• The master spreadsheet file is also able to be used as a search function.
• As a tool for determining priority, the spreadsheet could be sorted according to solar rating, or roof area available for PV etc.
CONCLUSIONS

• City operated buildings have a tremendous potential for solar power generation
• An ASU group did a similar project for the Tempe campus resulting in 16 MW of generation installed over several phases
• It is most likely that the city will use PPA’s to finance their solar plans although there may be opportunities for federal grants to aid in the financing
REFERENCES

1 - Derived from Census data by TEGNOS Research, Inc. (2008)

2 - Assumes an average 5 watt peak solar power production per square foot of suitable roof surface (200 billion square feet X 25% usage factor X 5 W/sf)
THANK YOU

QUESTIONS?