Conference: 7th INTERNATIONAL CONGRESS
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Title: Estimation of energy potential of the main crop residues generated in the state of Hidalgo, Mexico

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Editorial label ECORFAN: 607-8324
BCIE Control Number: 2016-01
BCIE Classification (2016): 221116-0101

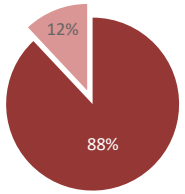
Pages: *26*
RNA: 03-2010-032610115700-14

Content

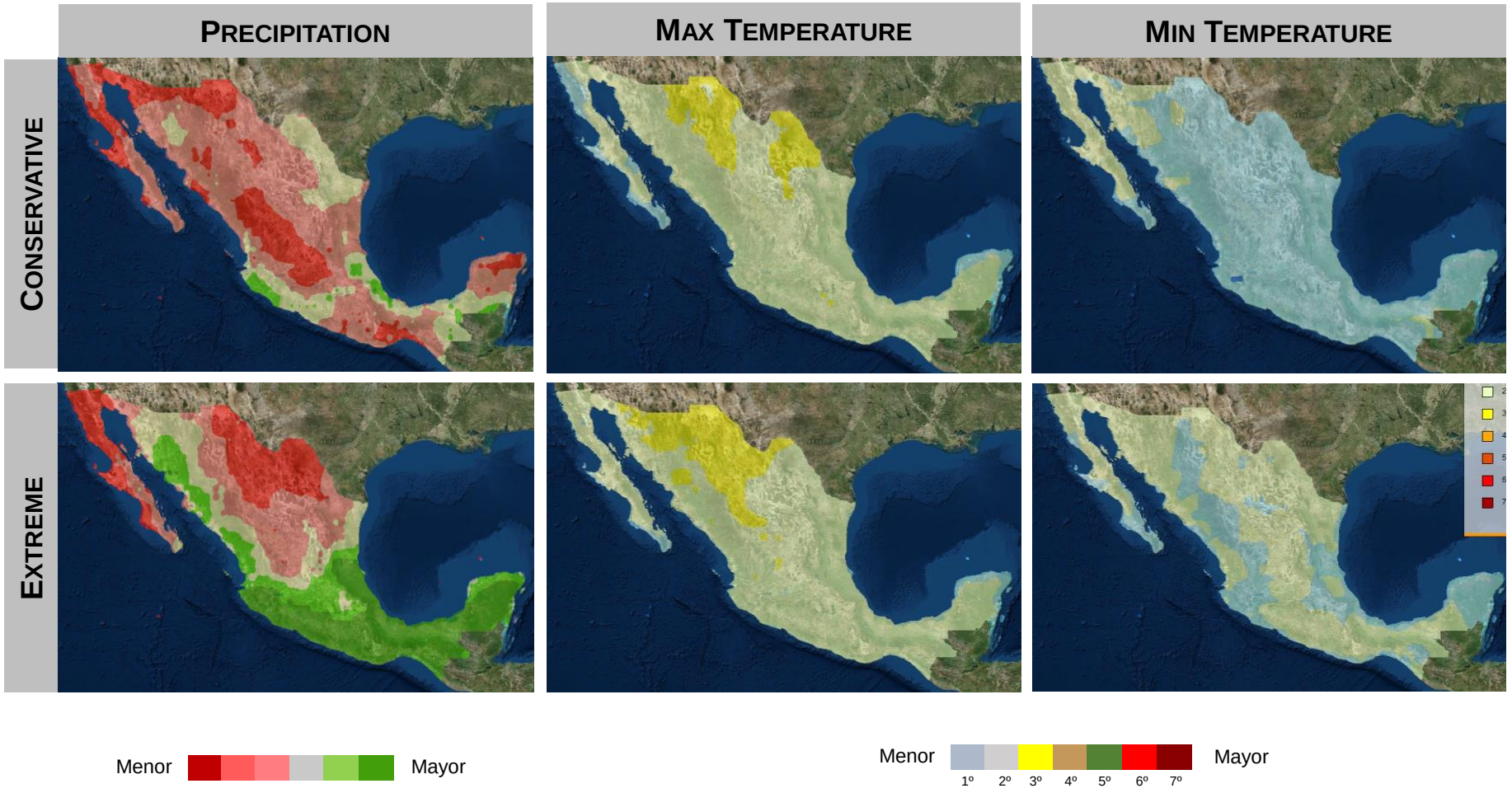
MEXICO FAST FACTS

Area	Total: 1,964,375 sq.km
Climate	From tropical to desert
Natural Resources	Petroleum, silver, copper, gold, lead zinc, natural gas and timber
Land use	Arable land 12.98%; permanent crops 1.36%, other 85.66% (2011)
Population	116,220,947 (Jul 2013)

Why a country with oil reserves needs to research about **reneweble energy**?

2010		2027
112,000,000 inhabitants		**130**,000,000 inhabitants
384 cities (>300,000)		**489** cities
72% of total population is concentrated in cities		**88% of total population is concentrated in cities**
25,000,000 of vehicles using gasoline and diesel		**70,000,000 of vehicles using gasoline and diesel**

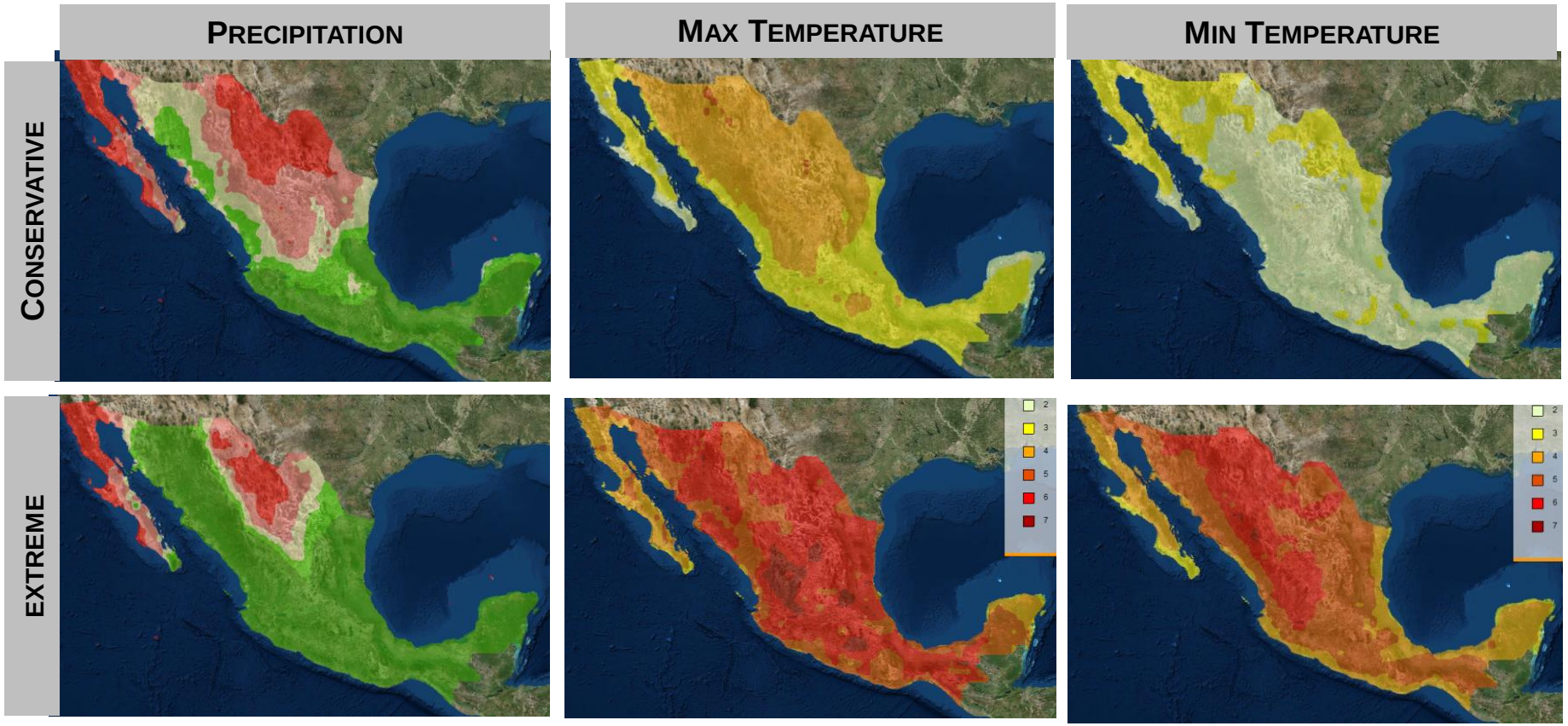
Secretary of Energy, 2014


PRECIPITATION
MAX TEMPERATURE
MIN TEMPERATURE
CONSERVATIVE
EXTREME
Menor
Mayor
Menor
Mayor
1º
2º
3º
4º
5º
6º
7º

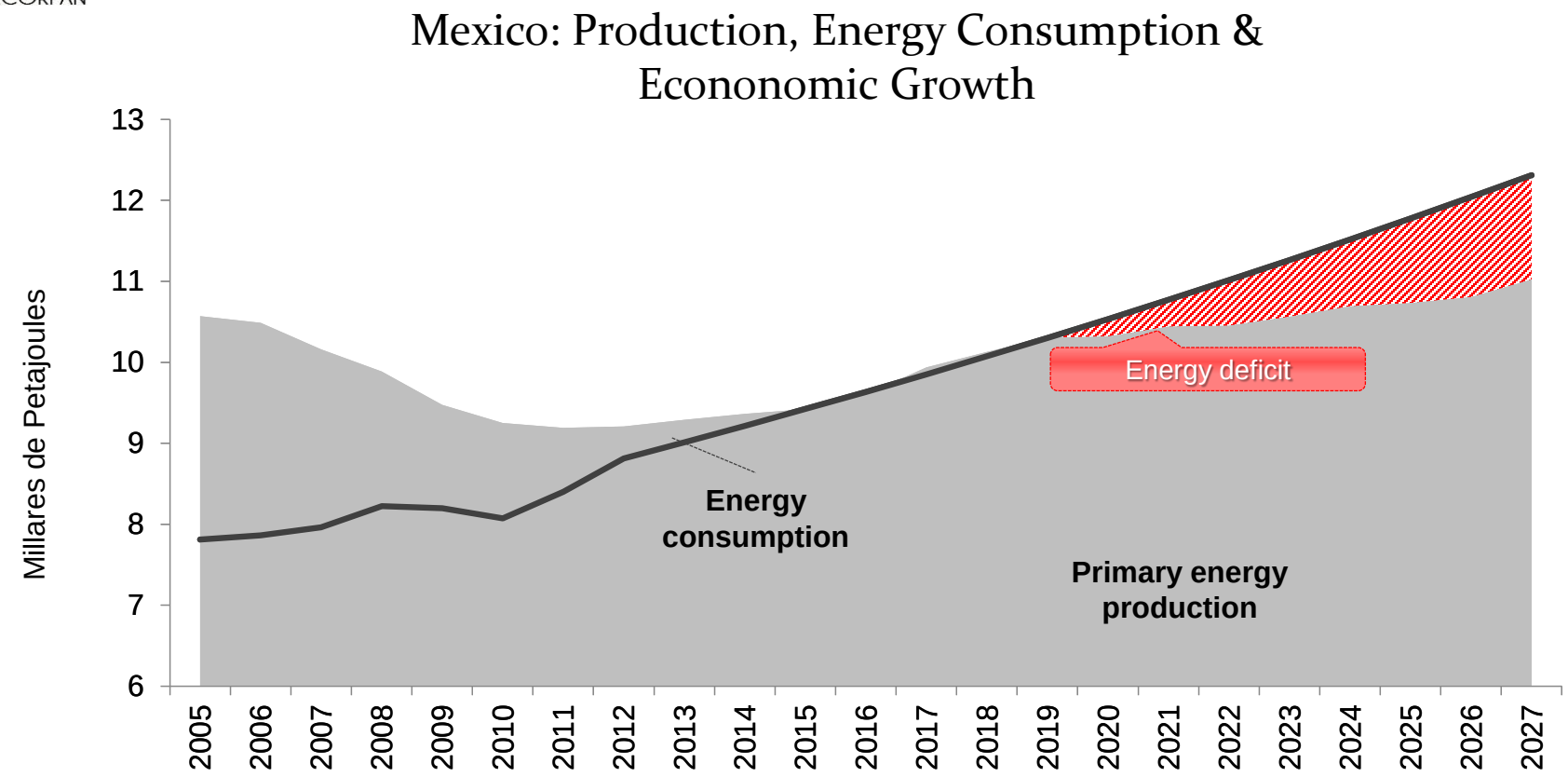
IPCC, 2010

Climate Change Scenario

2075-2099



IPCC, 2010

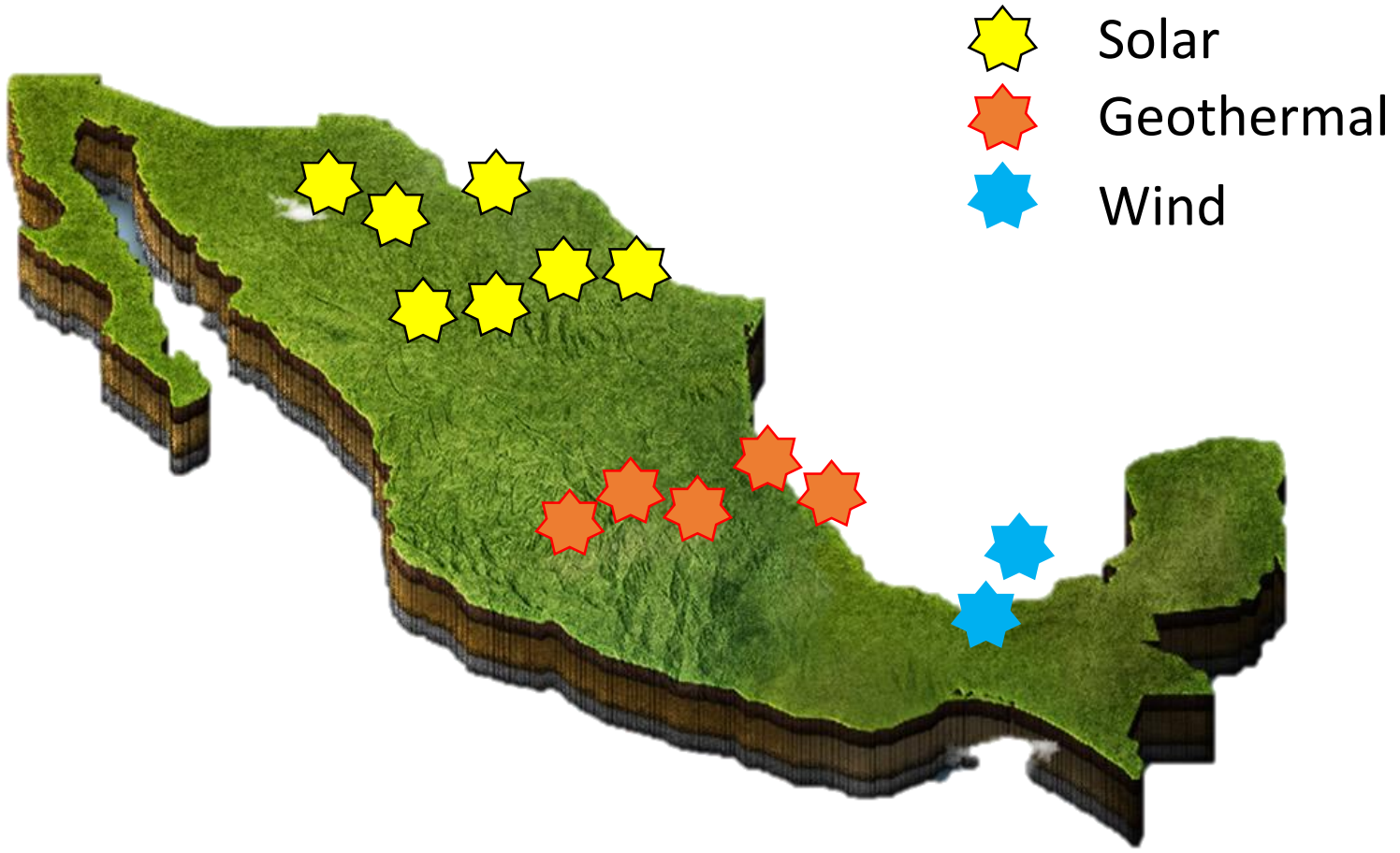

Mexico: Production, Energy Consumption & Econonomic Growth
Millares de Petajoules
13
12
11
10
9
8
7
6
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
2026
2027
Energy deficit
Energy consumption
Primary energy production

POTENTIAL

RENEWEABLE RESOURCES

ELECTRIC POTENTIAL GENERATION BY RENEWEABLE ENERGY (GWH/YEAR)

RESOURCES	POSSIBLE	PROBABLE	PROVED
GEOTHERMAL	16,165	95,569	892
HIDRAULIC	-	1,805	1,365
WIND	87,600	9,597	9,789
SOLAR	6,500,000	-	542
BIOMASS	11,485	391	579
TOTAL	**6,615,250**	**107,362**	**13,167**


Solar
Geothermal
Wind

Crop residue

Is defined as the non-edible plant parts that are left in the field after harvest.

(Lal 2004)

Methodology

Agricultural data
1. Cultivated area
2. Cultivar yield
3. Irrigation districts productivity

Hidalgo State
5 cultivars
Ten years (monthly)

4. Residue-to-producto ratio (RPR)
5. Humidity (H)
6. Higher Heating Value (HHV)

7. Livestock population

8. Carbon content in agricultural soils

Livestock per state/municipality
Per grazing period

Theoretical potential

$$TeP = Y * RPR * A(1 - H) * HHVdm$$

Where:
Y : Crop yield (Ton/ha)
RPR : Residue-to-Product Ratio
A : Cultivated area (ha)
H : Humidity of the residue (%)
HHVdm : High heating value (Kj/Ton)

(Hoogwijk et al, 2005)

Sustainable potential

The fraction of the theoretical potential that can be removed without negatively effecting soil health

$$S > E \quad SuP = TeP - (S * A * HHVdm)$$

$$S < E \quad SuP = TeP - (E * A * HHVdm)$$

S : Residues to maintain at least the 2% of organic matter in soil
E : Residues to cover the soil and reduce the 10% of soil erosion

Technical potential

$$TechP = SuP - (DCU * HHVdm)$$

DCU : Demand by competitive uses (Ton)

The competing uses are all off-field, non-energy uses of agricultural residues, for instance, farm and animal uses.

(Kadam and McMillan 2003)

The crop data were used for calculating the energy potentials from 2005 to 2014

Assumptions

- Calculations were done for the maximun hetating value (HHV) and minimun humidity content
- Harvest Residue-to-Product (H-RPR) was only considered
- No residues losses due transportation

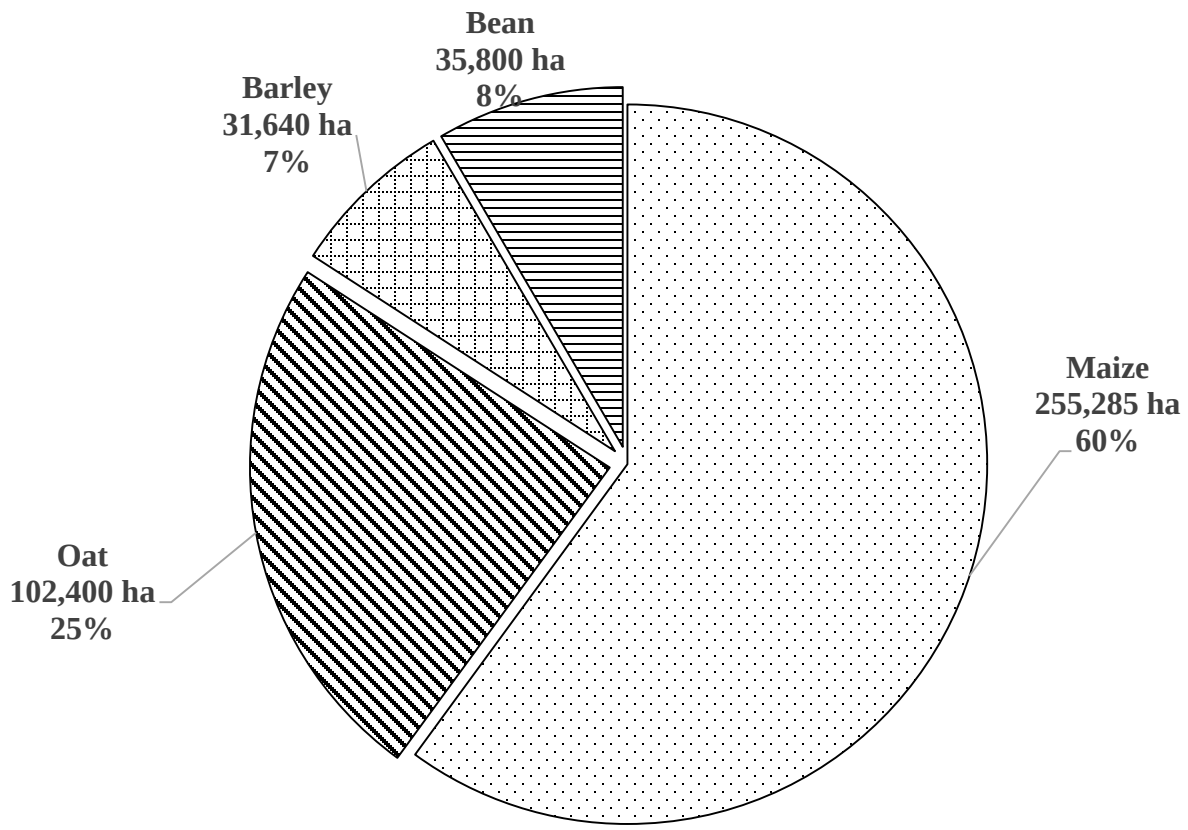
Results

Crop residues RPR, HHV and Humidity

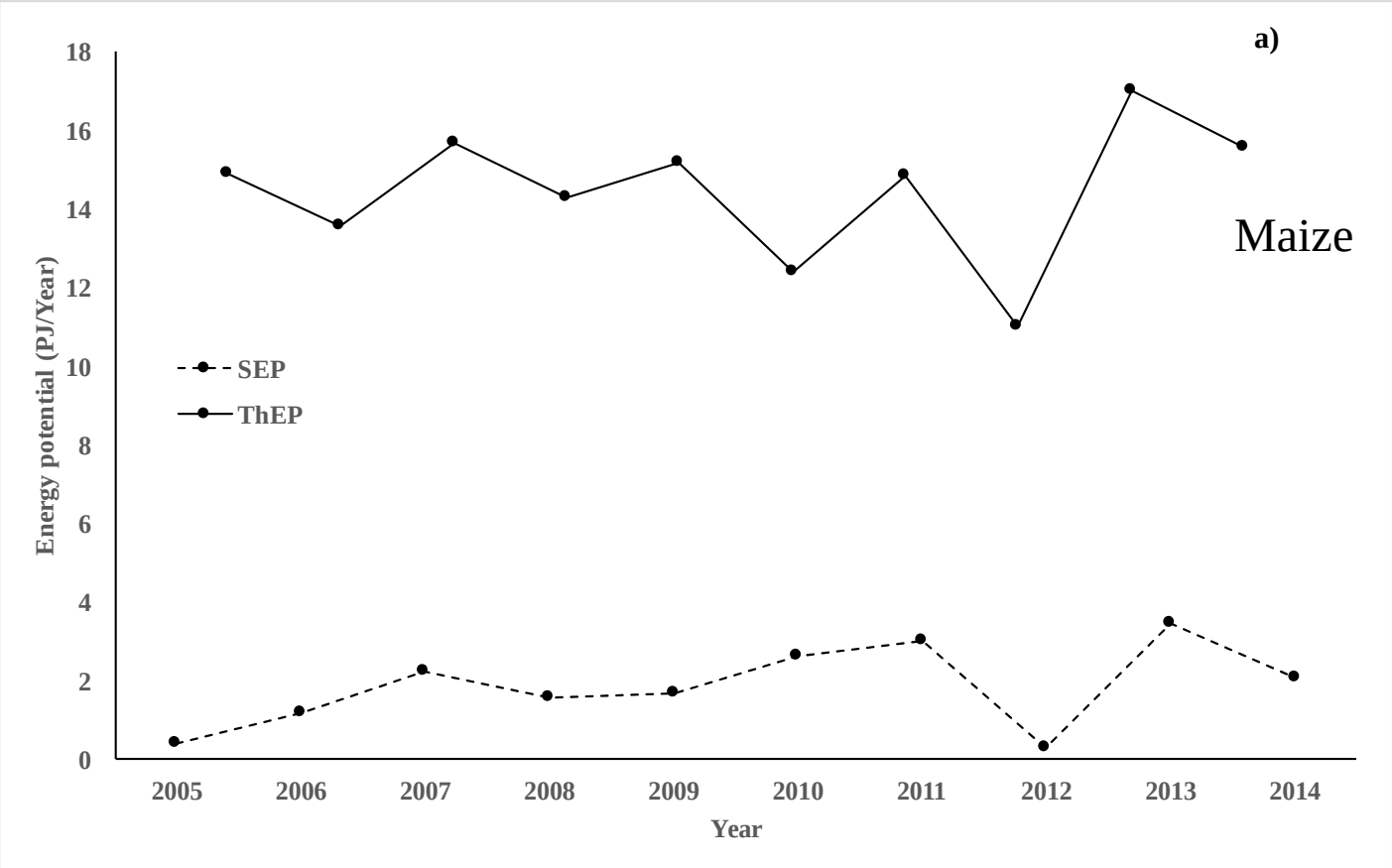
Cultivar	Production (Ton)	Cultivated area (ha)	Yield (Ton/ha)	Residue-to-Product Ratio (RPR)*	Heating Value GJ/Ton		Humidity (H)*
					MHV	HHV	
Corn	644,627	255,285	2.3	1.5	5	18.2	0.12
Oat	540,209	31,570	317.1	1.5	8.9	12.4.0	0.15
Barley	215,183	102,392	2.1	1.5	11.3	12.0	0.12
Bean	25,219	35,799	0.7	3.5	12.3	14.0	0.15

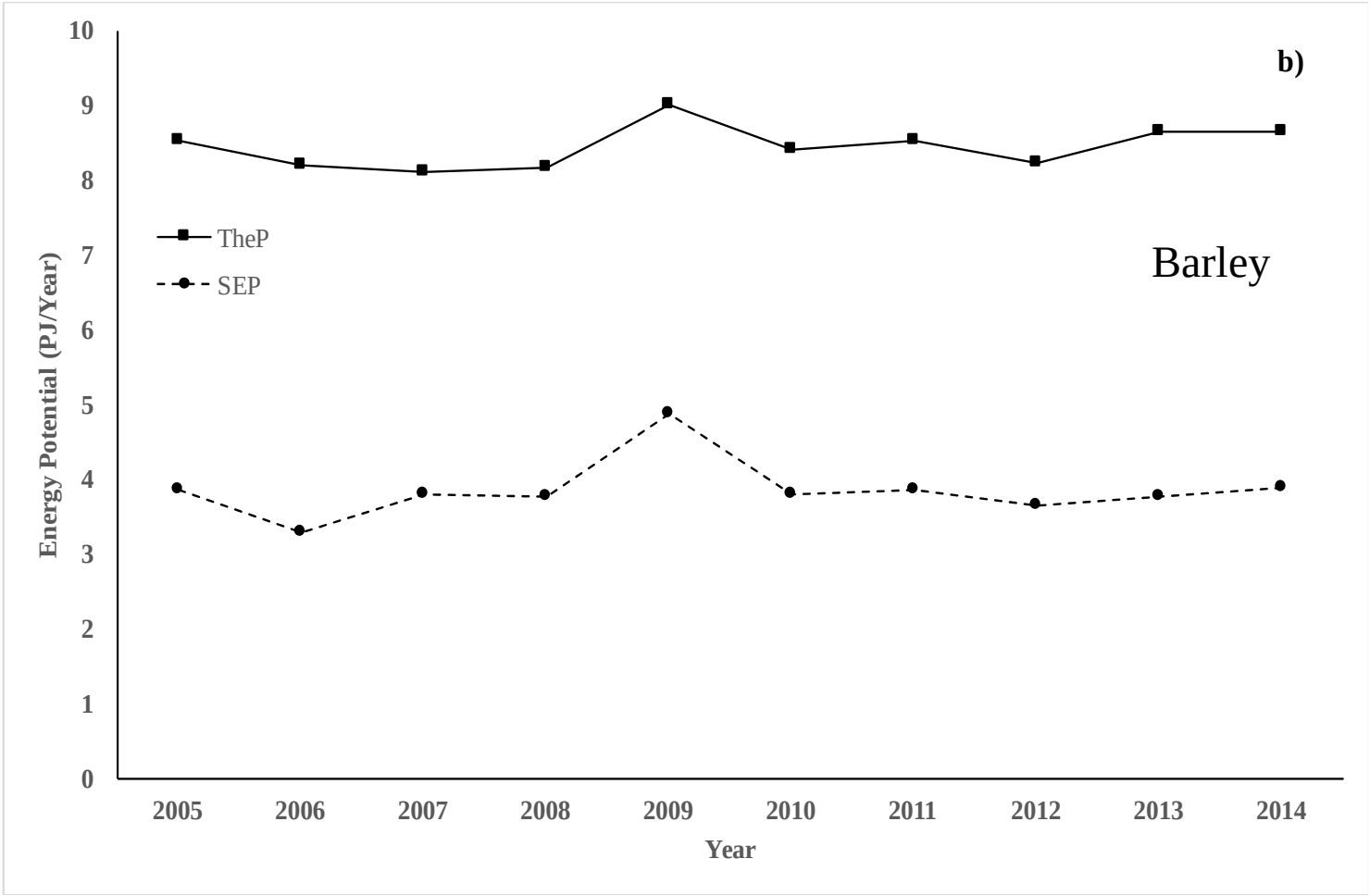
SAGARPA, 2016 * FAO Stats, 2015

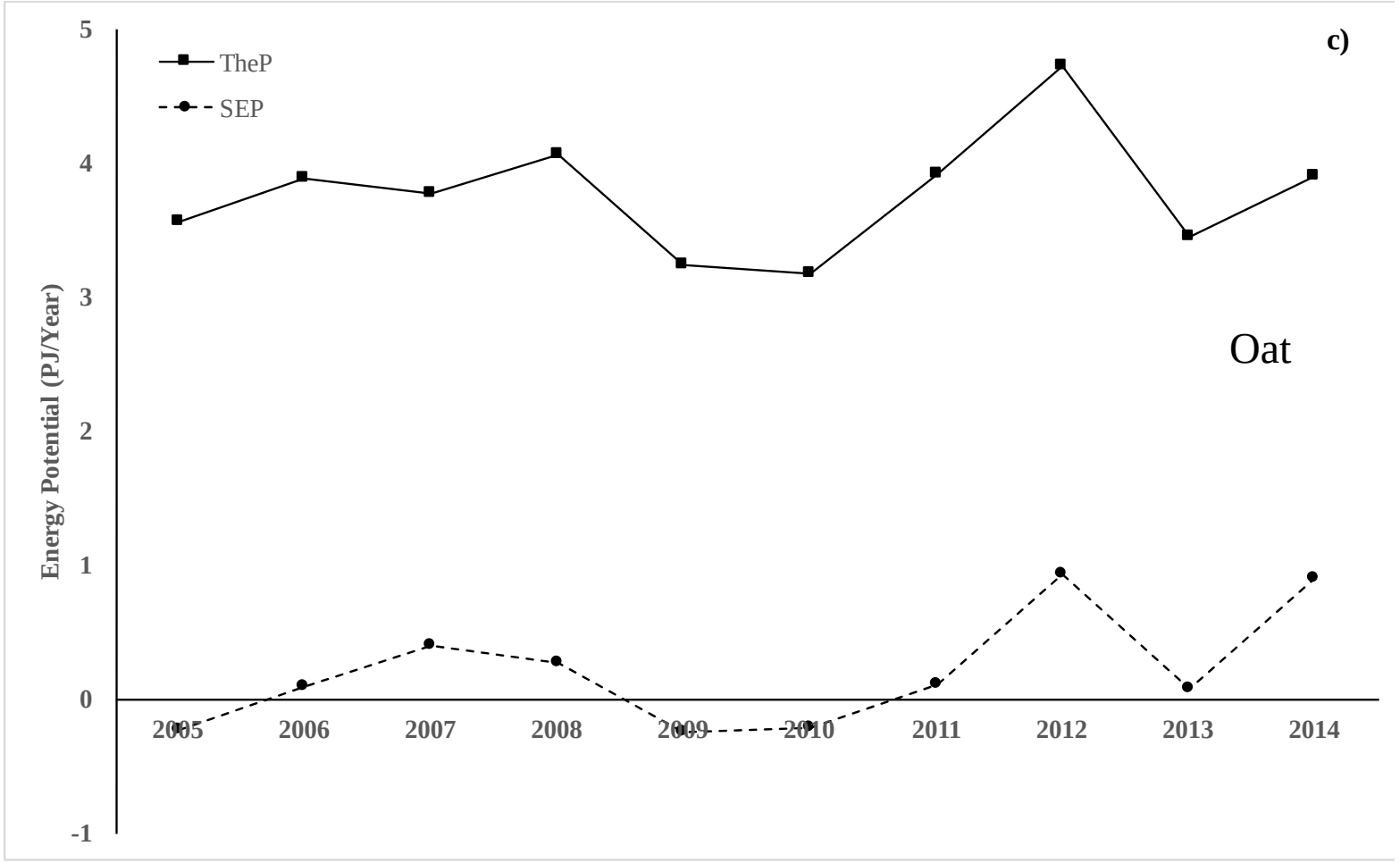
Cultivated area

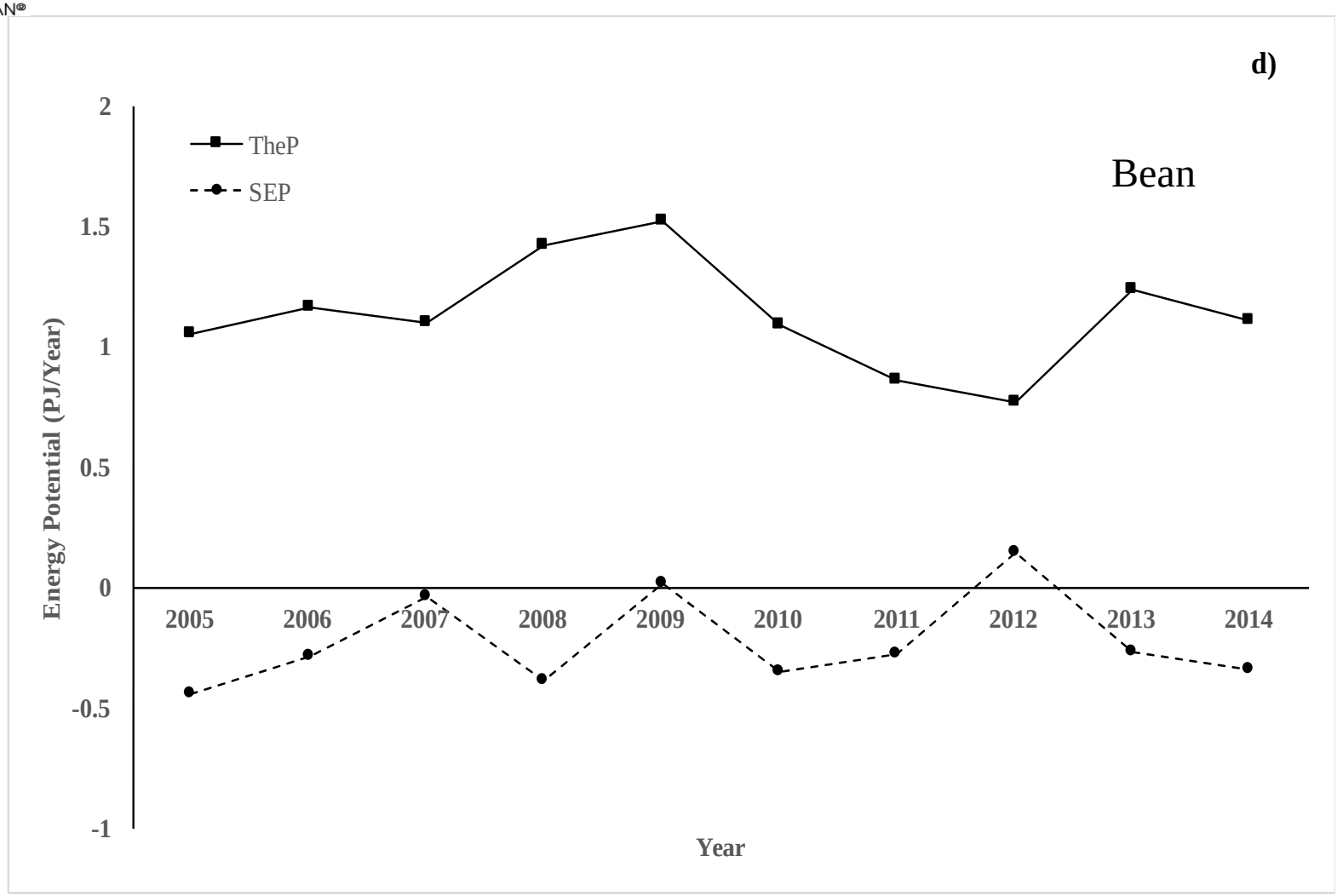


Theoretical and Sustainable Potential for the cultivars

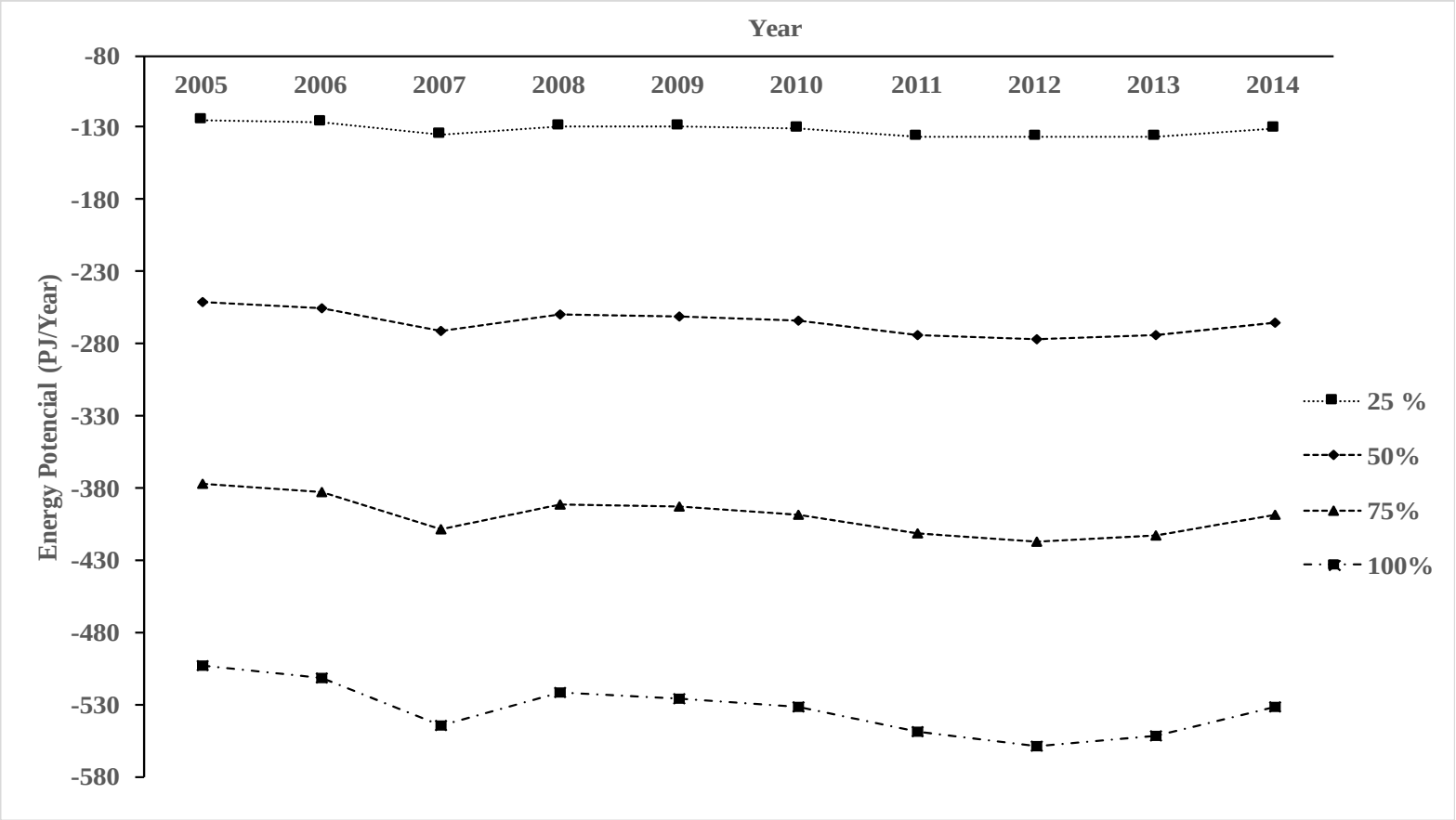



b)
Barley
TheP
SEP
Energy Potential (PJ/Year)
Year
0
1
2
3
4
5
6
7
8
9
10
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014


c)
TheP
SEP
Oat
Energy Potential (PJ/Year)
5
4
3
2
1
0
-1
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014


d)
Bean
TheP
SEP
Energy Potential (PJ/Year)
2
1.5
1
0.5
0
-0.5
-1
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
Year

Technical potential for maize



Conclusion

Agricultural residues generated in the state of Hidalgo, represent a sustainable source or energy, however, the implementation and development of appropriate technology for taking advantage of the biomass should be done after the inclusion of sustainable development, e.g. use of residues for house building, livestock feeding, carbon sequestration, erosion of soil and loss of fertility in cultivation land.

Forthcoming activities

The analysis of several residual crops using two biorefiney configurations:

- Conventional biochemical platform (CBP) that use fungal polysaccharides hydrolase enzymes
- Consolidated bioprocess (CB)

Thermodynamic analysis in exergy terms has been developed for both schemes in order to compare the efficiency of energy use

Acknowledgements

E.V-N would like to thank to B.V for her patient assistance. E. V-N and J.D. V-G received support of the Sciences and Engineering Division, Campus Leon, University of Guanajuato. T.Y F-M received support of the Technical University of Tula-Tepeji.

University of Guanajuato

References

Angelis-Dimakis, A., Biberacher, M., Dominguez, J., Fiorese, G., Gadocha, S., Gnansounou, E., & Robba, M. (2011). Methods and tools to evaluate the availability of renewable energy sources. *Renewable and Sustainable Energy Reviews*, *15*(2), 1182-1200.

Gallagher, P. W., Dikeman, M., Fritz, J., Wailes, E., Gauthier, W., & Shapouri, H. (2003). Supply and social cost estimates for biomass from crop residues in the United States. *Environmental and Resource Economics*, *24*(4), 335-358.

Hoogwijk, M., Faaij, A., Eickhout, B., de Vries, B., & Turkenburg, W. (2005). Potential of biomass energy out to 2100, for four IPCC SRES land-use scenarios. *Biomass and Bioenergy*, *29*(4), 225-257.

Kadam, K. L., & McMillan, J. D. (2003). Availability of corn stover as a sustainable feedstock for bioethanol production. *Bioresource Technology*, *88*(1), 17-25.

Lal, R. (2004). Soil carbon sequestration impacts on global climate change and food security. *science*, *304*(5677), 1623-1627.

SAGARPA, 2014 [online] México. [accessed: 14 de mayo de 2016] Base de datos con información sobre uso de residuos agrícolas, available at: http://www.gob.mx/sagarpa.

SIAP, 2016 [online] México. [accessed: 15 de mayo de 2016] Base de datos con información sobre productividad agrícola en México, available at: http://www.siap.gob.mx/

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